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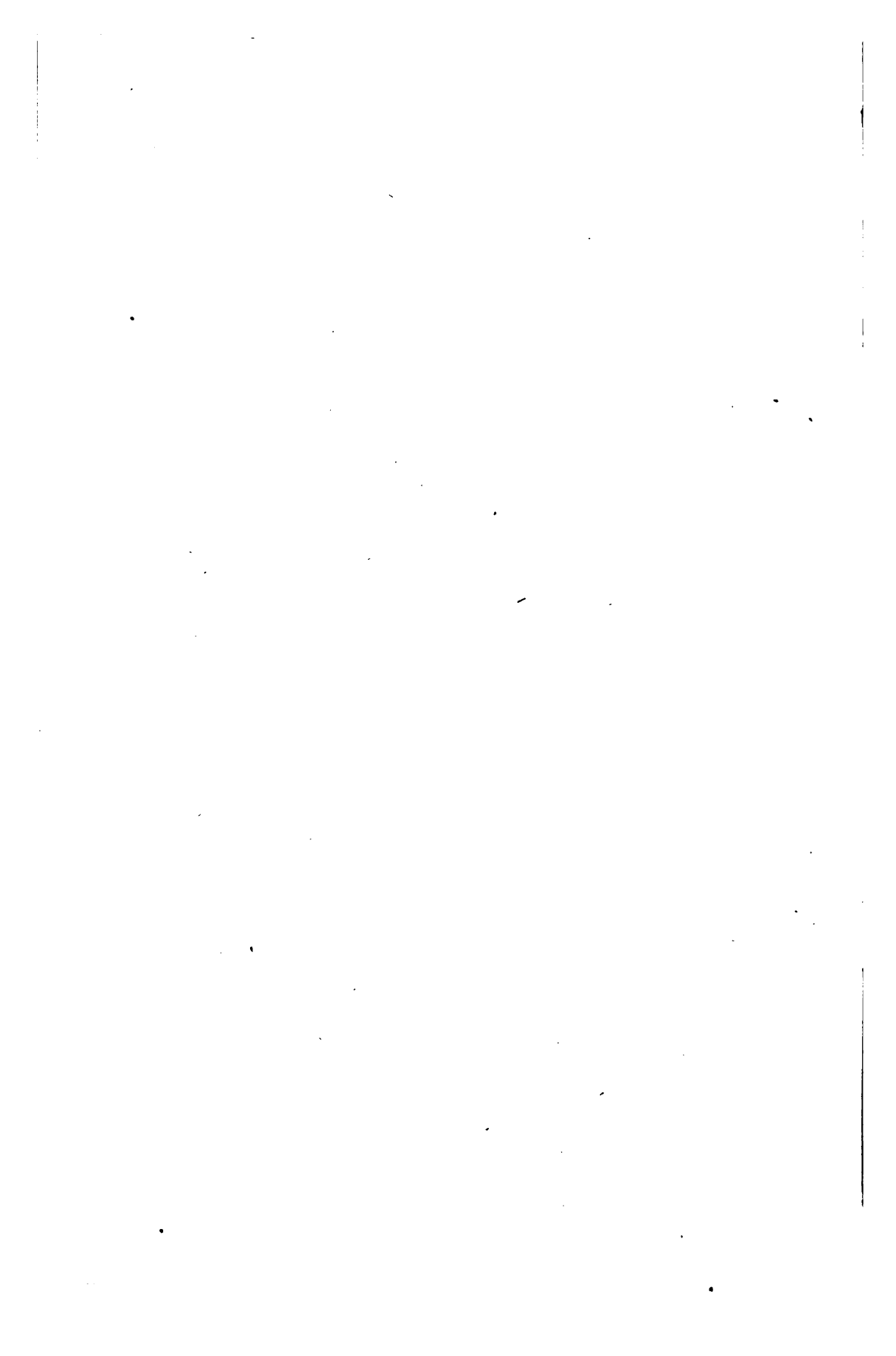
THROUGH *the*

U. S. Hydrographic
Office.

23 March, 1895.







U.S. - Hydrog. office.

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[Publ.] No. 108—Part II.

U.S. -



HYDROGRAPHIC OFFICE.

SAILING DIRECTIONS

FOR

LAKE MICHIGAN, GREEN BAY,

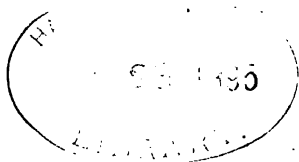
AND

STRAITS OF MACKINAC.

WASHINGTON :
GOVERNMENT PRINTING OFFICE.
1894.

~~VIII. 96~~

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U.S. Geological Survey, Washington

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PREFACE.

It is the intention of the Hydrographic Office to publish, as soon as possible, a complete set of sailing directions for the Great Lakes.

At present the sailing directions will be published in parts, beginning with Lake Superior, the present work being the second.

This will be followed in turn by Lake Huron with the St. Clair and Detroit rivers, and Lake St. Clair; and finally by lakes Erie and Ontario, with the St. Lawrence River to Montreal.

At Montreal the work will connect with Hydrographic Office publication No. 100, thus giving complete sailing directions from Duluth, Minn., to the Atlantic Ocean.

The general description of Lake Michigan has been obtained from various encyclopædia, and the description of the coast and harbors chiefly from the annual reports and bulletins of the Chief of Engineers, U. S. Army, from the charts published by the Hydrographic Office, the United States Engineers, and from special maps and letters from Major J. F. Gregory, and Captain W. L. Marshall, Corps of Engineers, U. S. Army.

The lighthouses, lightvessels, ranges, beacons, buoys, and daymarks are described from the publications of the U. S. Lighthouse Board.

Through Lieutenant G. P. Blow, U. S. Navy, in charge of the branch Hydrographic Office, Chicago, Ill., and through the courtesy of local authorities much valuable data has been procured.

It must be remembered that the first issue of such a work can not be complete and the Office must depend upon the cooperation of those who dwell near the lakes, as well as of those who navigate them, for prompt information concerning any errors or omissions, and such cooperation is earnestly requested.

The articles appended to this work are such as may be of interest and value to the mariner.

"The Rules of the Road for the Lakes, etc., of the United States."

"Signals: Weather, Storm, and Temperature, with Diagrams, United States and Canada."

"Brief Rules for the Use of Oil," with diagrams.

"Anchoring and Riding out Gales in Deep Water."

"Currents of Lake Michigan," with map, United States Weather Bureau.
Miscellaneous matter.

The thanks of the Office are due, for valuable information furnished in response to its circular letter, to—

Martin J. Russell, Collector of Customs, Chicago, Ill. ;

Samuel G. Artingstall, City Engineer, Chicago, Ill. ;

F. B. Higgin, Secretary of the Shipmasters' Association, Chicago, Ill. ;

R. Forsyth, 2d Vice President Illinois Steel Co., South Chicago, Ill. ;

J. S. Dunham, President Dunham Towing and Wrecking Co., Chicago, Ill. ;

James Pickands, President Minnesota Steamship Co., Cleveland, Ohio ;

H. F. Loftus, Master Str. "Manhattan," Inter-ocean S. S. Co., Windsor Park, P. O., Ill. ;

Geo. P. Hummer, Manager, West Michigan Furniture Co., Holland, Mich. ;

Charles Morton, Keeper U. S. Life Saving Station, Holland, Mich. ;

W. B. O. Sands, President Pentwater Bedstead Co., Pentwater, Mich. ;

Dr. Wm. M. Farr, Mayor of Kenosha, Wis. ;

H. S. Van Ingen, Superintendent Pennsylvania Coal Co., Chicago, Ill. ;

G. B. Parks, Special Deputy Collector of Customs, Grand Haven, Mich. ;

J. E. Hamilton, Mayor of Two Rivers, Wis. ;

G. Biedermann, Mayor of Port Washington, Wis. ;

James McCarthy, Harbormaster, Port Washington, Wis. ;

Frank Geele, Mayor of Sheboygan, Wis. ;

John McSweeney, Secretary Shipmasters' Association, Milwaukee, Wis.

August Ro-s, Collector of Customs, Milwaukee, Wis., and

Captain A. B. Davis, U. S. Revenue Cutter "Andrew Johnson."

This work has been prepared by Lieutenant D. H. Mahan, U. S. Navy, in charge of the Division of Sailing Directions ; assisted by Ensign James H. Reid, U. S. Navy.

The charts and illustrations were prepared by Mr. G. W. Littlehales, in charge of the Division of Chart Construction of this Office, and printed under his direction.

C. D. SIGSBEE,

Commander, U. S. Navy, Hydrographer.

NOTE.

The bearings, courses, and trend of the land are true, and given in points and degrees.

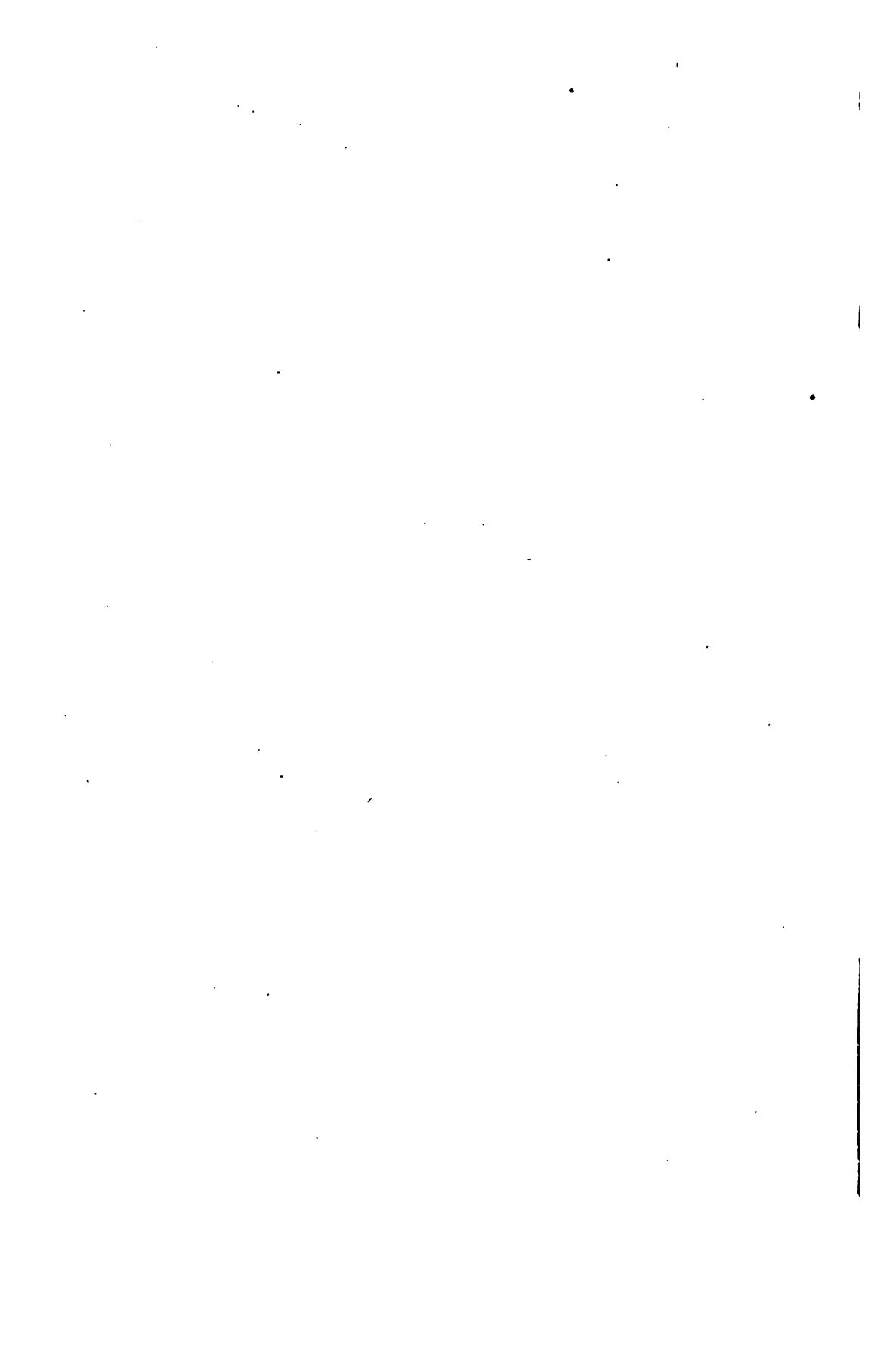
The directions of the winds, the points from which they blow; the directions of the currents, the points toward which they set.

Distances are expressed in nautical miles (the corresponding statute miles follow in parenthesis).

It is well to remember that on Hydrographic Office charts bearings and courses are *true*; distances are given in *nautical* miles.

On U. S. Engineer charts bearings and courses are *true*; distances are given in *statute* miles.

On British Admiralty charts bearings and courses are *magnetic*; distances are given in *nautical* miles.



**U. S. Engineers' charts to be used in connection with these
sailing directions.**

STRAITS OF MACKINAC.

No. 4. Straits of Mackinac.

LAKE MICHIGAN.

- No. 33. North end of Lake Michigan.
- No. 50. South end of Lake Michigan.
- No. 26. NE. end of Lake Michigan, etc.
- No. 10. Beaver Island Group, Lake Michigan.
- No. 27. North end of Green Bay, etc.
- No. 35. South end of Green Bay, etc.
- No. 55. Lake Michigan, Coast Chart No. 1.
- No. 54. Lake Michigan, Coast Chart No. 2.
- No. 52. Lake Michigan, Coast Chart No. 3.
- No. 59. Lake Michigan, Coast Chart No. 4.
- No. 51. Lake Michigan, Coast Chart No. 5.
- No. 57. Lake Michigan, Coast Chart No. 6.
- No. 58. Lake Michigan, Coast Chart No. 7.
- No. 68. Lake Michigan, Coast Chart No. 8.
- No. 62. Lake Michigan, Coast Chart No. 9.

The following British Admiralty charts also cover the coasts described :

- No. 301. Lake Michigan.
- No. 334. Mackinac Strait.

HYDROGRAPHIC OFFICE CHART.

No. 1865. Chicago, Illinois.

CHAPTER I.

LAKE MICHIGAN.

Lake Michigan derives its name from two Indian words of the Chipewewa dialect, *michi* (great) and *sawgyegan* (lake). It is the largest lake wholly within the United States and the second largest known body of fresh water in the world.

Lying in a north and south direction, it extends from long. $84^{\circ} 45'$ W. to long. $88^{\circ} 00'$ W., and from lat. $41^{\circ} 37'$ N. to lat. $46^{\circ} 05'$ N., a length of 320 miles, with an average width of 65 miles. The area of this grand sheet of water is 22,400 square miles, its circumference nearly 945 miles. Its surface is 581 feet above the Atlantic Ocean, and, being 1,000 feet deep, its bottom is over 400 feet below the surface of that ocean.

The Straits of Mackinac (formerly Michilimackinac, commonly Mackinaw), from 4 to 6 miles wide and 40 miles in length, connect this lake with Lake Huron. It is connected by canal with the Illinois River and so with the Gulf.

The shores of Lake Michigan are generally low and sandy, and the land slopes gradually to the lake. The northern shore of the lake is irregular, and more rugged and picturesque than the other shores, the summit of the highest peak being about 1,400 feet above the sea. On the eastern side are numerous sand hills formed by the wind into innumerable fantastic shapes, sometimes covered with stunted trees and scanty vegetation, but most generally bare, and rising to heights of from 150 to 250 feet. The southwestern shore is generally low, with sand hills covered with shriveled pines and burr oaks. Along the western shore, woods and prairie alternate, interspersed with a few high peaks. The cliffs on the east shore of Green Bay form a bold escarpment, and from this ridge the land slopes gradually to the lake. On this slope there is a remarkable series of drift hills and circular depressions called potash kettles.

From the appearance of the coast, Lake Michigan is believed to be moving slowly westward, uncovering the eastern and encroaching upon the western shore.

With the exception of Green and Traverse bays, Lake Michigan has few indentations in its coast line, and, excepting the north end, it is free from islands. The waters near shore are shoal, and, having few harbors, it is dangerous navigation in heavy blows. There are a number of streams flowing into the lake, but, with the exception of the Fox, flowing into Green Bay, and the Grand, Kalamazoo, and St. Joseph rivers in the east, they are unimportant.

The surface level of the lake is subject to fluctuations from one season to another as well as during the course of a season. In Lake Michigan the point of the lowest low water has been falling for seven years, and has so far fallen 5 feet. The average now is 0.16 feet below the lowest average recorded. A slight variation of the surface level is also due to a lunar tidal wave of its own. Observations have shown the difference of the level due to tide to be about 0.153 feet. At spring tides the difference between high and low water is 0.245 feet. High water occurs one-half hour after the meridian passage of the moon.

Around the lake the climate is quite equable, for, though the winter is cold and the summer hot, the waters of the lake modify the extremes. The mean temperature around the lake varies from 46° to 54° ; the average rainfall is 30 to 44 inches; the mean barometer varies from 29.5 to 30.01.

The country around Lake Michigan is exceedingly rich and fertile, and an immense commerce has sprung up along this lake.

Snow falls in the north before the occurrence of the heavy frosts. The northern part of the lake only is covered with ice in winter, and it never reaches as far south as Milwaukee. Milwaukee River remains closed on an average for 100 days, from the end of November to the middle of March.

The Straits of Mackinac, which longest retain the ice, are usually open between May 1 and December 1.

The finest agricultural land in the United States is near the lake, and there is an immense trade in all grains, fruits, live stock, and lumber, and their products, as flour, pork, hides, leather goods, furniture, etc. Rich lead and copper mines abound, as also salt, iron, and coal. Abundant water power promotes manufactures of all kinds. Beer and distilled liquors are made in this region, and fine building stone is obtained from numerous quarries.

NAVIGATION.

Navigation generally opens on the lake about the middle of April and closes about the middle of December.

The two great evils to navigation are fog and snow.

There are but light currents for the master to contend with on the lakes, and, as these are the most uncertain of all elements for the navigator to calculate and allow for, the per cent of danger in lake navigation is very much reduced. Hence, the safe navigation of the lakes is dependent upon a correct compass, with a knowledge and frequent use, on the part of the master, of the azimuth tables, the precaution to take cross bearings of prominent points and from them plotting the position frequently on the chart; also the familiar use of the chart in laying courses and correcting the same for variation and deviation.

The iron buoys are taken up every year at the close of navigation and the places marked by spar buoys of the same colors and numbers, and the lightvessels are removed about the same time. When they are replaced on the opening of navigation their positions are sometimes altered; masters of vessels are therefore cautioned to obtain the latest information on this subject and to keep their charts corrected.

HARBORS OF REFUGE.

Entrance of Sturgeon Bay Canal.—The entrance of the Sturgeon Bay and Lake Michigan Canal, on the NW. shore of the lake, has been improved by converging piers, and is now a fair harbor of refuge. Except in northerly gales the bay at the NW. end of the canal is an excellent harbor of refuge.

Milwaukee, on the western shore of the lake, has been improved. A breakwater sheltering it from NE. to SE. gales has been half completed. At present it is a very good harbor of refuge from NE. winds.

Chicago, on the southwestern end of the lake, is, with its exterior breakwater, an excellent harbor of refuge from northerly gales.

Grand Haven, with an entrance width of 390 feet, is the best harbor along the east coast for refuge from gales, but has no exterior breakwater.

Little Traverse has an excellent and well-sheltered natural harbor, though it is small and some distance from the direct routes of travel.

DANGERS.

Below are the principal dangers to be encountered in the navigation of Lake Michigan, each one being accurately and minutely described in passing from Chicago to the different ports around the lake.

The eastern shore is taken first, then the western as far as and including Green Bay, then the remainder of the coast to the Straits.

SOUTH SHORE.

Between Chicago and South Chicago are:

Oakland Shoal, with a least depth of 11 feet.

Morgan Reef, with a least depth of 7 feet.

Inner Hyde Park Shoal, with a least depth of 12 feet.

Hyde Park Shoal, with a least depth of 11 feet.

Madison Park Shoal, with a least depth of 16 feet.

South Park Shoal, with a least depth of 6 feet.

Clarke Point Shoal, with a least depth of 5 feet.

Cheltenham Shoal, with a least depth of 5 feet.

EAST SHORE.

As far north as Frankfort, with the exception of such shoals as are formed off the entrance of the harbors by the action of the rivers or during gales, there are no dangers. From there north the following dangerous shoals are found along the coast:

Platte River Point Shoal.—This is a dangerous rocky spit.

Pyramid Point, a 13-foot patch one mile north.

Good Harbor Bay Shoals.—There are several dangerous shoals here.

Carp River Shoals.—Four miles NE. of the dock at Carp River landing are two 12-foot spots.

Off Lighthouse Point and in the entrance of Grand Traverse Bay are several shoals close to shore.

Fishermans Island.—To the NE. is a 10-foot shoal.

South Manitou Island.—A rock lies SSW. distant 2 miles having 17 feet over it.

South Fox Island.—There are two shoal spots south of this island with 12 feet least water. One 3 miles, the other $6\frac{1}{2}$ miles distant. This latter is buoyed.

Most of the dangers in the lake lie in the NE. section, near the entrance. The following are the principal ones:

Ile aux Galets, with surrounding shoals.

Garden Island and Shoals.

Hog Island.

Hog Island Reef, about 3 miles S. by E. from Hog Island.

Hat Island and Reef.—A rock lies $\frac{1}{2}$ mile south from the south end of the island.

Squaw Island and Shoal.

Whiskey Island and Shoal.

Trout Island, with an 18-foot spot 2 miles W. by N. therefrom.

High Island, with a rock off NE. end.

Gull Island and Reef.—This reef, a rock awash, is about 4 miles SSE. from Gull Island.

Lansing Shoal, and

Grays Reef are grouped together with extensive shoals about them.

To the northward and eastward of these are:

Waugoshance Island and Shoal,

Vienna Shoal,

Rose Shoal, really two shoals,

White Shoal, and

Simmons Reef. All marked by lights or buoys.

NORTH SHORE.

The principal dangers on this shore beginning east are:

St. Helena Island, a reef extending $\frac{1}{2}$ mile SE. from the SE. point.

St. Helena Shoal, $1\frac{1}{2}$ miles west of the NW. end of the island.

Manitou Paymen Shoal,

Pelkie Reef, and

Potter Reef. Besides many rocks and shoals just off shore.

WEST SHORE.

There are no great dangers between Chicago and Racine, but off the latter port is

Racine Reef, and north of it, all along the coast, are detached spots, as follows :

Shoal SE. of Milwaukee Light,

Whitefish Point Shoal,

A Dangerous Shoal, North of Cave Point,

Bailey Harbor Shoal,

Cana Island,

North Bay Shoals,

Rowley Bay Shoals,

Spider Island and Shoals,

Outer Shoal, and

Gravel Island.

About the entrance of Porte des Morts are several islands and shoals, as follows :

Nine Foot Shoal on the south side,

Pilot Island, north side,

Plum Island, and

Detroit Island, with outlying shoals.

North of this a chain of islands and shoals extends to the northward and eastward.

The principal are :

Washington Island,

Rock Island. These two are connected by a reef.

Fishermans Reef, with another to the southward.

Two Patches, 10 and 16 feet respectively, between Rock Island and

St. Martin Island and Shoal,

Little Gull Island,

Gull Island,

Gravelly Island,

Gravelly Island Shoal,

Poverty Island,

Poverty Island Shoal,

Summer Island, shoals all around and connecting it with the mainland,

Little Summer Island—shoals all around and connecting it with the mainland, and

Rocky Island.

GREEN BAY.

Big Bay de Noquette and Little Bay de Noquette are full of shoals, and south of Peninsula Point, which separates them, are the following dangers :

Peninsula Point Shoal,

Eleven Foot Shoal,

Sixteen Foot Shoal,

Corona Shoal, and

Drisco Shoal.

Near the center of Green Bay are the following dangers :

Whaleback Shoal,

Chambers Island, and

Green Island, with the shoals about them.

On the west shore of Green Bay there are dangerous shoals near the entrance to Cedar River, and also the following to the southward :

Menomonee Shoal, south of Menomonee Harbor.

Peshtigo Shoal,

Pansaukee Shoal,

Little Tail Point Shoal,

Long Tail Shoal, and almost continuous flats down the coast and across the south end of the bay, extending out at least 3 miles.

On the east shore of Green Bay the principal dangers are :

Snake Island and the shoals between Little Sturgeon Bay and Sturgeon Bay,

Offlying Spots between this latter bay and Egg Harbor,

Hat Island Shoal,

Hat Island,

Strawberry Islands and Shoals,

Horseshoe Island,

Horseshoe Reefs,

Sister Shoals, and

Sister Islands, besides some shoal spots near shore.

CHAPTER II.

SAILING DIRECTIONS FROM THE STRAITS OF MACKINAC TO THE PRINCIPAL PORTS IN LAKE MICHIGAN.

Directions for entering harbors will be found under the head of each harbor, where will also be found a description of the harbor lights, fog signals, buoys, etc.

A description of the coast about any port will be found under the heads, "CHICAGO TO -----."

In case of deep-draft vessels (20 feet or over) it is best not to pass close to Waugoshance point on account of several 20-foot spots about there, but to keep to the northward of Rose shoal and then bear up for the southern ports. This course is described under the head of "CHICAGO TO THE STRAITS OF MACKINAC AND MACKINAC CITY."

SAILING DIRECTIONS.

From a point N. 20° W. from Mackinac City light and distant $1\frac{1}{2}$ ($1\frac{3}{4}$) miles steer W. $\frac{1}{4}$ S. (S. $87^{\circ} 11'$ W.), $14\frac{1}{2}$ (17) miles, until Waugoshance light bears on port beam, distant $\frac{3}{4}$ mile. From this point courses can be shaped to any port on Lake Michigan.

Caution.—The eastern end of Rose shoal is unmarked.

To Traverse City.—From the point of departure off Waugoshance light, steer SW. $\frac{1}{2}$ S. (S. $39^{\circ} 22'$ W.), $7\frac{1}{2}$ ($8\frac{1}{2}$) miles, until Ile aux Galets bears SE. about $2\frac{1}{2}$ ($2\frac{1}{2}$) miles, when head SSW. (S. $22^{\circ} 30'$ W.) for $38\frac{3}{8}$ ($44\frac{1}{2}$) miles until North Port Point bears NW., $1\frac{1}{2}$ ($1\frac{1}{2}$) miles, when head S. by W. (S. $11^{\circ} 15'$ W.) for the dock at Traverse City, distant $21\frac{1}{2}$ ($24\frac{1}{2}$) miles.

To Little Traverse.—From the point given off Ile aux Galets head S. by E. $\frac{1}{4}$ E. (S. $14^{\circ} 04'$ E.), $9\frac{1}{2}$ ($10\frac{1}{2}$) miles, to a point $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off Middle Village, from which point skirt the coast, keeping at least one mile off shore, to the harbor 12 (14) miles distant. A course can be made inside of Ile aux Galets, but no change should be made to the southward until well clear of Vienna shoal on the course SW. $\frac{1}{2}$ S. (S. $39^{\circ} 22'$ W.). Then by bringing Waugoshance light astern and heading S. $\frac{3}{4}$ W. ($8^{\circ} 26'$ W.) until Ile aux Galets light bears abeam, all dangers will be cleared.

FROM THE ENTRANCE OF LAKE MICHIGAN TO PORTS ON THE EAST AND SOUTH SHORES.

From the point of departure off Waugoshance light, head SW. $\frac{1}{2}$ S. (S. $39^{\circ} 22'$ W.), $85\frac{1}{10}$ (98) miles, until Point Betsey light bears east, distant 4 ($4\frac{1}{2}$) miles, then head as follows:

To—	Courses.	Distance	When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance to the harbor.
		<i>Miles.</i>	
Frankfort	SE. $\frac{1}{2}$ S. (S. $39^{\circ} 22'$ E.)	$4\frac{3}{4}$ ($5\frac{1}{4}$)	Stand into the harbor.
Portage Lake	S. $\frac{1}{2}$ E. (S. $5^{\circ} 37'$ E.)	$18\frac{1}{4}$ ($22\frac{1}{4}$)	Head in on range.
Manistee	S. $\frac{1}{4}$ W. (S. $2^{\circ} 48'$ W.)	$26\frac{1}{2}$ ($30\frac{1}{4}$)	Do.

For ports to the southward : From the point off Point Betsey head S. by W. $\frac{1}{2}$ W. (S. $16^{\circ} 52'$ W.), $38\frac{1}{2}$ ($44\frac{1}{2}$) miles, until Big Point Sable light bears abeam, distant 4 ($4\frac{1}{2}$) miles, then head as follows :

To—	Courses.	Distance	When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance to the harbor.
		<i>Miles.</i>	
Ludington	SE. by S. (S. $33^{\circ} 45'$ E.)	$8\frac{3}{4}$ ($10\frac{1}{4}$)	Head in on range.
Pentwater	S. by E. $\frac{5}{8}$ E. (S. $18^{\circ} 16'$ E.)	$17\frac{1}{4}$ ($19\frac{3}{4}$)	Do.
St. Joseph	S. $\frac{1}{4}$ E. (S. $2^{\circ} 49'$ E.)	119 (137)	Do.
Michigan City	S. $\frac{1}{2}$ W. (S. $5^{\circ} 37'$ W.)	$142\frac{1}{2}$ (164)	Stand into the harbor.

For ports to the southward of Pentwater (except St. Joseph and Michigan City): From the point off Big Sable head S. $\frac{1}{4}$ E. (S. $2^{\circ} 49'$ E.), $25\frac{1}{2}$ ($29\frac{1}{2}$) miles, until Little Point Sable light bears abeam, distant $1\frac{1}{2}$ (2) miles, then head as follows :

To—	Courses.	Distance	When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance to the harbor.
		<i>Miles.</i>	
White River	S. by E. $\frac{5}{8}$ E. (S. $18^{\circ} 17'$ E.)	$17\frac{1}{2}$ ($20\frac{1}{4}$)	Stand into the harbor.
Muskegon	{ From off White River head } SSE. (S. $22^{\circ} 30'$ E.)	$10\frac{1}{2}$ (12)	Head in on range.
Grand Haven	{ From off White River head } SSE. (S. $22^{\circ} 30'$ E.)	$20\frac{3}{4}$ (24)	Do.
Holland	S. by E. $\frac{1}{2}$ E. (S. $16^{\circ} 52'$ E.)	$55\frac{1}{2}$ (64)	Do.
Kalamazoo River	S. by E. $\frac{1}{4}$ E. (S. $14^{\circ} 04'$ E.)	$62\frac{1}{2}$ (72)	Stand into the harbor.
South Haven	S. $\frac{7}{8}$ E. (S. $9^{\circ} 51'$ E.)	$77\frac{1}{4}$ (89)	Do.

To Chicago.—From the point off Waugoshance light, head SW. $\frac{3}{4}$ S. (S. $36^{\circ} 33'$ W.), 85 (98) miles, keeping at least $\frac{1}{4}$ mile east of Vienna Shoal buoy. With North Manitou open on starboard bow keep well clear of Pyramid and Sleeping Bear points.

When Point Betsey bears east, distant 4 ($4\frac{1}{2}$) miles, head S. by W. $\frac{1}{2}$ W. (S. $16^{\circ} 52'$ W.), 176 ($202\frac{1}{2}$) miles, which will carry to a point $1\frac{1}{2}$ ($2\frac{1}{2}$) miles east from Chicago Pierhead light, from which run into the harbor.

To Calumet (South Chicago).—Steer as if for Chicago until off Point Betsey, when head S. by W. $\frac{3}{8}$ W. (S. $15^{\circ} 28'$ W.), $182\frac{1}{2}$ (210) miles, keeping well clear of the dangerous reefs and shoals south of Chicago, to a point $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance, when head into the harbor.

FROM THE ENTRANCE OF LAKE MICHIGAN TO PORTS ON THE WEST SHORE.

From the point of departure off Waugoshance light steer SW. $\frac{1}{2}$ S. (S. $39^{\circ} 22'$ W.), $85\frac{1}{10}$ (98) miles, until Point Betsey light bears east, distant 4 ($4\frac{1}{2}$) miles, then for the southern ports on this shore steer as follows :

To—	Courses.	Distance	When $1\frac{1}{8}$ ($1\frac{1}{2}$) miles off the entrance to the harbor.
		<i>Miles.</i>	
Waukegan	SSW. $\frac{1}{8}$ W. (S. $23^{\circ} 54'$ W.) --	$153\frac{1}{4}$ (176 $\frac{1}{2}$)	Stand into the harbor.
Kenosha	SSW. $\frac{3}{8}$ W. (S. $26^{\circ} 43'$ W.) --	$141\frac{1}{4}$ (163)	Do.
Racine	SSW. $\frac{1}{2}$ W. (S. $28^{\circ} 07'$ W.) --	$132\frac{1}{4}$ (152 $\frac{1}{2}$)	Do.
Milwaukee	SW. by S. (S. $33^{\circ} 45'$ W.) --	$120\frac{3}{4}$ (139)	Do.
Port Washington	SW. $\frac{1}{2}$ S. (S. $39^{\circ} 22'$ W.) --	$102\frac{1}{4}$ (118)	Do.

The intermediate ports may be reached by passing either to the northward or southward of the Manitous. The courses to the southward are recommended and are as follows: Having run 65 (75) miles on the course SW. $\frac{1}{2}$ S. (S. $39^{\circ} 22'$ W.) and with South Manitou light abeam, distant 3 ($3\frac{1}{2}$) miles, steer as follows :

To—	Courses.	Distance.	When $1\frac{1}{8}$ ($1\frac{1}{2}$) miles off the entrance to the harbor.
		<i>Miles.</i>	
Sheboygan	SW. $\frac{1}{8}$ S. (S. $43^{\circ} 36'$ W.) --	102 (117 $\frac{1}{2}$)	Head in on the range.
Manitowoc	SW. $\frac{5}{8}$ W. (S. 52° W.) --	$74\frac{3}{4}$ (86)	Stand into the harbor.
Two Rivers	SW. $\frac{5}{8}$ W. (S. 52° W.) --	$71\frac{1}{4}$ (82)	Do.

For the Northern Ports on the Western Shore courses to the northward of the Manitous can be made as follows : From the point off Waugoshance light run $3\frac{1}{2}$ (4) miles on the course SW. $\frac{1}{2}$ S. (S. $39^{\circ} 22'$ W.) until clear of the shoals, when change course to

SW. $\frac{1}{2}$ W. (S. $50^{\circ} 37'$ W.) for $37\frac{1}{10}$ ($42\frac{1}{2}$) miles, keeping well off Beaver Island, passing South Fox light abeam, distant $1\frac{1}{2}$ ($1\frac{3}{4}$) miles and keeping to the northward of South Fox shoals.

South Fox light abeam to—	Courses.	Distance.	When $1\frac{1}{8}$ ($1\frac{1}{2}$) miles off the entrance to the harbor
		<i>Miles.</i>	
Keweenaw	SW. $\frac{5}{8}$ W. (S. $52^{\circ} 02'$ W.) --	$89\frac{1}{2}$ (103)	Head in on the range.
Abnapee	SW. by W. (S. $56^{\circ} 15'$ W.) --	$82\frac{3}{4}$ (94 $\frac{3}{4}$)	Do.
Sturgeon Bay Canal	SW. by W. $\frac{5}{8}$ W. (S. $60^{\circ} 28'$ W.) --	$71\frac{3}{8}$ (82 $\frac{3}{4}$)	Stand into the harbor.
Bailey Harbor	WSW. $\frac{1}{8}$ W. (S. $68^{\circ} 54'$ W.) --	$57\frac{3}{4}$ (66 $\frac{1}{2}$)	Head in on the range, the lights being 3 miles distant.

TO GREEN BAY BY THE PORTE DES MORTS CHANNEL.

From the point off Waugoshance light make a course SW. $\frac{1}{2}$ S. (S. $39^{\circ} 22'$ W.) for $3\frac{1}{2}$ (4) miles, until clear of the shoals, when head

SW. by W. (S. $56^{\circ} 15'$ W.), $21\frac{1}{2}$ ($24\frac{1}{2}$) miles, until Beaver Island light bears abeam, distant $1\frac{1}{2}$ ($1\frac{1}{2}$) miles, when head

WSW. $\frac{3}{4}$ W. (S. $74^{\circ} 31'$ W.) for 60 (69) miles, to a point one mile south of Pilot Island light, then head

NW. (N. 45° W.) for 3 ($3\frac{1}{2}$) miles, until the NW. end of Plum Island bears abeam, from which point take departure to the different ports in Green Bay. .

Caution.—Keep a lookout for the shoals to the southward of the entrance to Porte des Morts Channel.

See Chicago to ports in Green Bay, Wisconsin.

TO GREEN BAY BY THE ROCK ISLAND CHANNEL.

Head as in the preceding case to abeam of Beaver Island light, then head W. $\frac{1}{2}$ S. (S. $84^{\circ} 22'$ W.), $54\frac{1}{2}$ (63) miles, until Rock Island light bears abeam, distant $\frac{1}{2}$ mile, when take departure for the different ports in Green Bay.

Caution.—Keep a lookout for the shoals to the NE. and SE. of Rock Island.

See Chicago to ports in Green Bay, Wisconsin.

TO GREEN BAY BY THE POVERTY ISLAND PASSAGE.

Head as above until abeam of Beaver Island light, then shape a course of W. $\frac{1}{4}$ S. (S. $87^{\circ} 11'$ W.), $46\frac{8}{10}$ (54) miles, to a point one mile south of Poverty Island light from which point follow directions given under the head of Poverty Island Passage, **Chicago to ports in Green Bay, Wisconsin.**

To Green Bay by the Poverty Island Passage, going to the northward of the islands.—From the point N. 20° W. of and $1\frac{1}{2}$ ($1\frac{3}{4}$) miles distant from Mackinac City light, head

W. $\frac{1}{4}$ N. (N. $81^{\circ} 34'$ W.), 36 ($41\frac{1}{2}$) miles, until Squaw Island light bears abeam, distant $2\frac{6}{10}$ (3) miles, when head

SW. by W. $\frac{3}{4}$ W. (S. $64^{\circ} 41'$ W.), $50\frac{1}{2}$ ($58\frac{1}{2}$) miles, to a point one mile south of Poverty Island light, when head up Poverty Island Passage as described above.

To Manistique.—Head as in the preceding case until abeam of Squaw Island light, from which point shape course W. $\frac{1}{4}$ N. (N. $81^{\circ} 34'$ W.) for 27 (31) miles, when head NW. $\frac{1}{4}$ N. (N. $42^{\circ} 11'$ W.), 2 ($2\frac{1}{2}$) miles, which will bring a vessel $\frac{1}{2}$ mile off the entrance to the river, when head in.

CHAPTER III.

PORTS.

Chicago.—This is the second city in the United States in size and commercial importance, incorporated in 1837, and has (1894) a population of about 1,500,000. It is in the State of Illinois, at the southwestern end of Lake Michigan, and at the mouth of the Chicago River, from which it takes its name, the original name being derived from an Indian word, Chacaqua, meaning thunder. The city is 14 feet above the lake level and covers an area of 180.14 square miles.

Dearborn University, connected with the Chicago University, has a fine observatory, $3\frac{1}{2}$ miles south and $\frac{3}{4}$ mile east from the court house, in lat. $41^{\circ} 50' 01''$ N., and long. $87^{\circ} 34' 08''$ W.

The Chicago River runs through the city from the lake nearly one mile west, then separates into two branches, one running NW., the other SW., dividing the city into three divisions which are connected by many bridges and tunnels. A canal connects the main or SW. branch with the Illinois River and so with the Mississippi and the Gulf. This channel has been so deepened that the waters of the river and the lake flow through into the Illinois and Mississippi, thus carrying off the sewage of the great city to the Gulf, but this system is at present inadequate and pumps have to be used until further improvements are completed.

The system of water supply has been called one of the wonders of the world, the water being drawn from cribs well out in the lake through tunnels, carrying it under the streets, to widely separated parts of the city, to stations whence it is distributed by powerful pumps. There is also a system of cisterns connected with the tunnels, for use in case of fire or other emergency. The water is pure, cold and wholesome, and the supply inexhaustible.

The fire department of the city is probably the finest in the world, and fire tugs are kept ready for use.

There are numerous hospitals and many public libraries.

The climate of Chicago is much modified by the lake; the mean temperature for 17 years was 48.6° , varying between a mean of 24° in January and a mean of 72° in August, the mean temperature of the water for the same period being 48° , varying from 32.9° to 67.6° . There is a marked preponderance of land winds (SW.) during the winter and a slight preponderance of lake winds (NE.) in the summer, this being an average of 18

years observations. The mean annual rainfall in the country surrounding Chicago is 34 inches, taken from observations of 47 years. The death rate was lower than that of any other city of its size in 1892 and 1893.

Chicago is a port of entry, and an immense amount of traffic passes through, it being the first city in the country as far as arrivals and departures of vessels are concerned, though it is second to New York in tonnage.

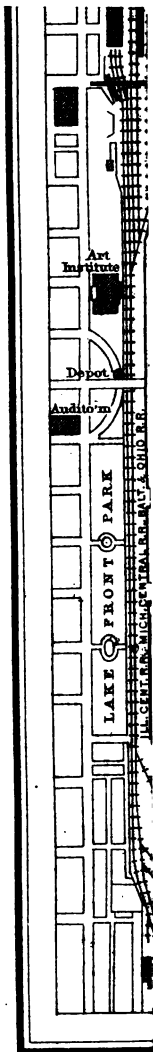
Merchandise may be shipped direct from foreign ports to Chicago by being transported in bond from port of first entry. The number of vessels making direct trips to Europe is increasing. There is also an immense number of railroads entering the city, affording unrivaled facilities for shipping goods to all parts of the country.

The grain elevators are great features of the city, vessels being loaded and unloaded by machinery. The principal trade is in live stock, pork packing, and other products of the farm and dairy, flour, grain, seed, manufactures of steel and iron, leather, shoes, chemicals, wines, brewing and distilling, cigars, tobacco, etc.

Harbor.—The harbor of Chicago consists of an inner and an outer harbor; the former being the Chicago River, which has been dredged and its mouth protected by piers 500 feet apart at the entrance, but the river is so filled with docks as to be very cramped and crowded for the immense commerce. Constant dredging is necessary to keep out the accumulation of sand brought down by a NE. lake current, which has made many acres of new land on the north side of the entrance. The outer harbor is formed by the North Pier, an eastern breakwater, and a southern breakwater, and incloses a basin of 270 acres of 16 feet depth, to the south and east of the river entrance.

The North Pier reaches east in continuation of the north bank of the river and extends 200 yards beyond the eastern breakwater, which is commonly known as the Chicago North Breakwater. It is 4,036.5 feet long, running perpendicularly (S. $0^{\circ} 37'$ W.) from the North Pier, and about 3,300 feet from shore; a dock line 1,300 feet from shore and 2,000 feet from the eastern breakwater and parallel to it has been established, but the docks have not yet been built out to this line. The southern breakwater, commonly known as the Chicago South Breakwater, extends SW. by S. 3,000 feet from the end of the eastern breakwater, completing the basin. There are three entrances to this harbor. The outer harbor had, the latest information, from 14 to 15 feet of water in it.

The outer breakwater, beginning at a line running north from the end of the North Pier and about 5,000 feet from that pier, extends S. $59^{\circ} 34'$ E., 5,413 feet with a depth of from 18 to 32 feet of water inside of it, forms an excellent harbor of refuge for vessels and renders it easy for vessels to enter the Outer Harbor of Chicago.



The western half of this area has but 20 feet or less of water.

The entrance channel to the harbor has been dredged to a depth of 20 feet, with a width of 250 feet at the eastern and 200 feet at the western end. At the latest information this channel had slightly shoaled, but there was a depth of 18 feet at extreme low water. There is a depth of 18 feet of water at the entrance of the river. Three of the tunnels have but 16 to 18 feet of water over their crowns. Only a small part of the river has over a 15-foot depth of water.

The draft of vessels entering the river is limited to the depth of water over the crown of the La Salle street tunnel, which is 16 feet, 8 inches, as an average. This depth is in the exact center of the river on a line between the central piers of the Clark street bridge and Wells street bridge.

There are no public wharves or docks. The buildings are in many cases so near the docks as to prevent dredging deeper than 16 or 18 feet close to them. There are about four bridges to the mile which seriously interfere with navigation.

Tugs should be employed in all movements of vessels above the junction of the two branches.

The navigable length of the Chicago River is for the South branch about 5 miles from the mouth up to McCormick's Reaper factory. The North branch is navigable about $4\frac{1}{2}$ miles up to Western avenue. The stream is very crooked in places, and varying in width as follows: Main branch 274 feet; south branch 205 feet; the Forks 100 to 150 feet; north branch 100 to 200 feet; and somewhat less beyond the Forks.

There is a harbor master to regulate the passage of vessels.

Lights and Fog Signals.—Chicago Outer Breakwater (NW. end), a fixed white lantern is shown from a post attached to the SE. side of the building on the Emergency Intake Waterworks Crib, an extension north-westerly of the outer breakwater.

Chicago Harbor.—A light, flashing alternately red and white at intervals of 10 seconds, visible $13\frac{2}{10}$ (16) miles, and $67\frac{1}{2}$ feet above the level of the lake, has been established in the tower on the structure recently erected inside of and near the SE. extremity of the outer breakwater. The light illuminates the entire horizon.

Fog Signal.—A steam whistle in a house alongside the tower of the Chicago Harbor light sounds blasts of 5 seconds duration with silent intervals of 25 seconds.

Chicago Pierhead Range.—A fixed white light, visible $11\frac{3}{10}$ (13) miles, is shown from a tower 40 feet from the outer end of the North Pier, entrance to the river, and a fixed red lantern is shown from a post on the outer end of the same pier.

Fog Signal.—Near the outer end of the North Pier, entrance to the

river, a bell is struck by machinery a double and a single blow alternately, with silent intervals of 20 seconds.

Chicago Breakwater (north).—A fixed white light is shown from the top of a post on the northerly end of this breakwater.

Chicago Breakwater (south).—A fixed red light, visible $8\frac{1}{2}$ ($9\frac{1}{4}$) miles, is shown from a tower on the southerly end of this breakwater.

Chicago Avenue Waterworks Crib.—A fixed white light visible $13\frac{3}{10}$ (16) miles is shown from a white lantern on an iron framework tower, 58 feet high, built on a stone crib. It is 4,300 feet N. by E. $\frac{3}{8}$ E. (N. $15^{\circ} 28'$ E.) from the SE. end of the outer breakwater. This station is maintained by the city of Chicago.

Fog Signal.—On Chicago Avenue Waterworks Crib a bell is struck by machinery about 12 times every minute.

Cribs.—Off Lake View, $3\frac{1}{2}$ (4) miles north of the outer breakwater, are two cribs, one temporary 1 ($1\frac{1}{10}$) mile, and one permanent $1\frac{1}{2}$ ($1\frac{8}{10}$) miles from shore, marked by white lights.

There were two cribs SE. of the entrance to Chicago Harbor $2\frac{1}{2}$ and 4 miles respectively from shore. The $2\frac{1}{2}$ -mile one has been removed to the water level and is now a dangerous obstruction to navigation. The 4-mile one is completed.

At Hyde Park, $2\frac{1}{2}$ miles NW. of Calumet light, there are two cribs $1\frac{1}{2}$ ($1\frac{3}{10}$) and $1\frac{7}{8}$ ($2\frac{1}{10}$) miles respectively from the Hyde Park Waterworks; both are marked by white lights. A tower is to be erected on the outer crib.

The color of the permanent lights on these cribs is white.

These lights are all maintained by the city of Chicago.

Life-Saving Stations.—There is a Life-Saving Station 7 miles S. by E. from Chicago Harbor entrance with a branch near the harbor.

Wharfage.—During the season of navigation, beginning April 1 and ending November 30, it is not customary to charge wharfage, so long as the owner does not wish to use his dock, but during the winter vessel owners pay from \$10 to \$100 for special accommodations.

Tugs.—Tugs are owned by the Chicago Towing Company, Vessel Owners Towing Company, Dunham Towing and Wrecking Company, and the Independent Tug Line; also a number of private parties own tugs for special purposes.

Charges are moderate for the distance towed. These charges are regulated by a tariff scale for the distance and size or tonnage of the vessel towed. Charges are on an average of \$10 an hour for ground work. The average cost of towing steamers is \$75 per trip, consort or barges \$130, and sailing vessels \$45.

Dry Dock.—The Chicago Ship Building Company has completed, at their ship yard on the Calumet River, a large dry dock capable of accommodating any vessel on the lake.

Miller Brothers' Dry Dock Company.—This company has 3 docks, the largest being 310 feet long, with a 50-foot gate and 14 feet of water on the mitre sill at ordinary stage of tide; the second is 280 feet long, 42-foot gate, with 12 feet water on the mitre sill; and the smallest is 260 feet long, 40-foot gate, and 9 feet of water on the mitre sill. There is also at the yard a spar derrick capable of lifting 25 tons, besides a full outfit for making repairs of all sorts to wooden vessels.

Directions for Entering the Harbor.—Vessels having reached the point $1\frac{1}{2}$ ($2\frac{1}{4}$) miles east from Chicago Pierhead light may enter from the west or east end of the outer breakwater, or from either end of the eastern breakwater, these ends being marked by lights. Vessels may then come to anchor behind the breakwaters or steer for the mouth of the river, which is marked by a range of lights, where they will be taken charge of by a harbor tug in charge of a licensed pilot, who will take the vessel to the dock to which she may be consigned.

No vessel is allowed to use sails in the river.

Making the harbor from the northeastward, pass $\frac{1}{4}$ mile east of the Chicago Waterworks Crib light, on a course of south, until the North Pierhead light bears W. by S. ($S. 78^{\circ} 45' W.$), when run in on this course for the entrance.

Approaching along the land from the northward and intending to pass between the west end of the breakwater and the shore, bring the North Pierhead light to bear S. by E. ($S. 11^{\circ} 15' E.$) and run down on this course until close to the light.

To enter the Outer Harbor from the southward, bring the light on the south end of the eastern breakwater to bear west, stand in through the entrance, and, as you pass the light, haul up to the northward for anchorage.

Currents.—There is no perceptible current in the Chicago River, except when a sudden change of wind raises or lowers the lake surface, or when an exceptionally high freshet occurs, setting a current out into the lake. Near the end of the piers at the entrance to the river a current has been noticed which sometimes forces vessels against the piers.

Pilotage.—Tug masters are licensed and responsible pilots. All steamboat masters who navigate the river or harbor are also licensed pilots.

Time Ball.—A time ball is dropped from a flagstaff on top of the Masonic Temple, by the U. S. Branch Hydrographic Office, at Chicago, daily (Sundays excepted) at noon, Central Standard Time.

CHAPTER IV.

SAILING DIRECTIONS FROM CHICAGO TO THE PORTS ON THE SOUTH AND EAST SHORES.

Stand out of Chicago Harbor steering east from Chicago Pierhead light for $1\frac{1}{8}$ ($2\frac{1}{4}$) miles, then steer as follows:

To—	Courses.	Distance.	When $1\frac{1}{8}$ ($1\frac{1}{2}$) miles off the entrance to the harbor.
		<i>Miles.</i>	
Calumet (South Chicago)	S. by E. $\frac{3}{8}$ E. (S 15° 28' E.)	$9\frac{1}{8}$ ($10\frac{1}{2}$)	Stand into the harbor.
Michigan City -----	ESE. $\frac{1}{2}$ E. (S. 73° 08' E.)	30 ($34\frac{3}{4}$)	Head in on the range.
St. Joseph -----	ENE. $\frac{1}{2}$ E. (N. 73° 08' E.)	$49\frac{1}{2}$ (57)	Do.
South Haven -----	NE. by E. $\frac{3}{8}$ E. (N. 60° 28' E.)	$64\frac{3}{4}$ ($74\frac{1}{2}$)	Stand into the harbor.
Kalamazoo River -----	NE. $\frac{5}{8}$ E. (N. 52° 02' E.)	$75\frac{1}{2}$ (87)	Do.
Holland -----	NE. $\frac{1}{4}$ E. (N. 47° 49' E.)	$80\frac{3}{4}$ (93)	Head in on the range.
Grand Haven -----	NE. $\frac{1}{2}$ N. (N. 39° 22' E.)	$91\frac{1}{8}$ ($105\frac{1}{2}$)	Do.
Muskegon -----	NE. by N. (N. 33° 45' E.)	$97\frac{1}{8}$ ($112\frac{3}{4}$)	Do.
White River -----	NNE. $\frac{1}{2}$ E. (N. 28° 08' E.)	$103\frac{3}{4}$ ($119\frac{1}{2}$)	Stand into the harbor.
Pentwater -----	NNE. (N. 22° 30' E.) until Little Point Sable light bears abeam, distant $1\frac{3}{4}$ (2) miles, then NNE. $\frac{1}{2}$ E. (N. 28° 08' E.)	$116\frac{3}{4}$ ($134\frac{1}{2}$)	
Ludington -----	N. by E. $\frac{1}{8}$ E. (N. 21° 06' E.)	10 ($11\frac{1}{4}$)	Head in on the range.
Manistee -----	N. by E. $\frac{5}{8}$ E. (N. 18° 17' E.) until Big Point Sable light bears abeam, distant $2\frac{3}{4}$ (3) miles, when head NE. $\frac{3}{4}$ N. (N. 36° 34' E.)	$134\frac{1}{8}$ (155)	Do.
Portage Lake -----	Same course to Big Point Sable, then head NE. by N. (N. 33° 45' E.)	$14\frac{1}{8}$ ($16\frac{1}{2}$)	Do.
Frankfort -----	N. by E. $\frac{3}{4}$ E. (N. 19° 41' E.)	$21\frac{3}{4}$ (25)	Do.
		175 ($201\frac{1}{2}$)	Do.

For Traverse City, etc., see body of this work.

Chicago to Calumet Harbor.—The land is low and very flat along the coast, nowhere much over 20 feet above the level of the lake.

Leaving Chicago Harbor bound for the southward or eastward, keep at least 2 miles off shore. This will carry outside of all dangers. Courses can be laid nearer shore, but many shoal spots will be encountered.

Oakland Shoal.—Off 41st street, Chicago, $4\frac{1}{2}$ (5) miles from the entrance to the river a sand spit called Oakland shoal extends out $\frac{3}{4}$ mile with 9 feet least water near the center of the shoal.

Buoys.—The outer (easterly) end is marked by a black can buoy in 26 feet of water; the inner (westerly) end by a red spar buoy $\frac{1}{2}$ mile from shore, in $16\frac{1}{2}$ feet of water. These buoys are $\frac{3}{8}$ mile apart.

Morgans Reef.—About a mile to the southward of Oakland shoal, off the wharves at Hyde Park, Morgans reef extends a mile from shore; the outer end with 7 to 16 feet of water thereon being rocky, and the inner part with a least depth of 3 feet.

From Morgans reef to the World's Fair Pier shoal water extends $\frac{3}{4}$ mile. One-half mile east from the pier is a large 18-foot spot.

Buoys.—The outer end of Morgans reef is marked by a black spar buoy, and the inner end by a red spar buoy. One half mile south of the outer buoy are 2 spots with 18 feet of water on them.

There is a narrow passage with a depth of 12 feet which small vessels can use between Chicago and Calumet, passing between the inner buoy and the shore, but closer to the buoy.

Hyde Park Shoals.—One-half mile to the eastward of Morgans reef is the Inner Hyde Park shoal with 12 feet of water on the northern end; 2 detached spots of 17 and 18 feet depth north of it, and one of 17 feet SE. of it. Nearly a mile to the eastward and 2 ($2\frac{1}{2}$) miles from shore is the Outer Hyde Park shoal with 11 feet of water.

Buoys.—1. Hyde Park Outer shoal; a red and black horizontal stripe nun buoy marks the northern point of this shoal.

2. Hyde Park Inner shoal, a red and black horizontal stripe spar buoy marks the north side of this shoal.

Madison Park Shoal Buoy.—Three-quarters of a mile to the SW. of Hyde Park shoal is a red and black horizontal stripe spar buoy in 15 feet of water, 1 ($1\frac{1}{2}$) mile off shore.

Vessels will clear the shoal by giving the buoy a berth of 300 feet.

South Park Shoal.—One mile south of Outer Hyde Park shoal, nearly half way between Chicago and Calumet harbors and $1\frac{3}{4}$ ($2\frac{1}{2}$) miles from shore is South Park shoal with 6 to 11 feet of water on its shoalest part.

Buoy.—The south side of the 6-foot shoal is marked by a red and black horizontal stripe can buoy in 28 feet of water.

Inside of this shoal and of the Hyde Park Shoal buoy there is a channel $\frac{7}{8}$ mile wide. Vessels using it must keep $\frac{1}{2}$ mile to the westward of the buoys, being careful to avoid the Madison Park shoal.

Cribs.—A mile south of this and a mile east of the World's Fair Pier is the Hyde Park Waterworks Inner Crib, and distant $\frac{3}{4}$ mile NE. by E. $\frac{1}{4}$ E. (N. $59^{\circ} 04'$ E.) from this crib is the outer crib.

These cribs, marked by white lights in cupolas 50 feet high, are not yet completed. The inner crib is to be abandoned.

From the site of the World's Fair Pier to Clarke Point the shoal water extends $\frac{1}{2}$ mile from shore.

Clarke Point Shoal.—About 2 miles north of Calumet light Clarke Point shoal makes out $\frac{7}{8}$ of a mile from shore, with 11 feet of water on its northern end, and with rocky 5-foot spots $\frac{3}{4}$ mile from shore and a 4-foot

spot $\frac{1}{2}$ mile from shore. A detached 18-foot spot $\frac{1}{4}$ ($1\frac{1}{2}$) mile from shore is off its northern end.

Buoy.—The outer end is marked by a red spar buoy, just outside the 18-foot patch, in 18 feet of water.

Caution.—Vessels should not pass between this buoy and the shore.

Cheltenham Shoal.—Three-quarters of a mile south of Clarke Point shoal and $\frac{3}{8}$ mile from shore is Cheltenham shoal, with a rocky spot of 5 feet depth of water.

Calumet Bar consists of several parts; one, having 19 feet of water on it, lies $1\frac{1}{2}$ ($1\frac{1}{2}$) miles NE. by E. $\frac{3}{8}$ E. (N. $60^{\circ} 28'$ E.) from Calumet Pierhead light and extends $\frac{3}{8}$ mile to the southward. Outside of the North Pier are bars on either side of the channel with but 17 feet of water on them.

Caution.—The outer bar lies directly in the axis of the channel, consequently care should be exercised when approaching it.

On the south side of the entrance to Calumet, shoal water extends $\frac{3}{4}$ mile from shore, and for 3 miles to the southeastward it extends $\frac{1}{2}$ mile from shore.

Buoys.—A black spar buoy marks the south bank of the channel into Calumet River. It is in 18 feet of water.

A red spar buoy, in $18\frac{1}{2}$ feet of water, marks the north bank.

Chicago to Michigan City.—Keep at least $\frac{1}{2}$ mile from shore.

Between Chicago and Michigan City the coast is low and marshy for the first half of the way, when comes a succession of small hills rising frequently to heights of 100 and 150 feet.

There are no shoals more than $\frac{1}{2}$ mile from shore other than those already mentioned, with this exception: $6\frac{1}{2}$ ($7\frac{1}{2}$) miles southeastwardly from Calumet Pierhead light are two 18-foot spots 2 miles off shore.

Michigan City to St. Joseph.—Keep at least $\frac{1}{2}$ mile from shore.

Between Michigan City and St. Joseph the coast is regular and runs NNE., with occasional small hills and low bluffs, until 17 (20) miles beyond Michigan City, when a hill called "Bald Tom" rises to a height of 320 feet $\frac{1}{2}$ mile from the coast. North of this for a distance of about 7 ($8\frac{1}{2}$) miles a range of hills 200 to 300 feet high (one of them rising to a height of 390 feet) extends along the coast. The eastern coast of Lake Michigan is noted for the numerous sand hills, sometimes covered with stunted trees, but generally bare, which have been thrown up by the wind into fantastic shapes. The continuation of the coast is a line of low bluffs.

Shoal.—There are no shoals more than $\frac{1}{2}$ mile from shore until off St. Joseph Pier, to the SW. of which there is a depth of 11 feet of water $\frac{1}{2}$ mile from shore. This is a shifting shoal.

Buoy.—A red spar buoy marks the NW. point of this shoal.

St. Joseph to South Haven.—Keep at least $\frac{1}{2}$ mile from shore.

Between St. Joseph and South Haven the coast line is nearly straight, consisting principally of low bluffs, with occasional hills rising above them.

South Haven to Kalamazoo River (Saugatuck).—Between South Haven and Kalamazoo River the coast line is regular, with low bluffs rising to a height of 260 feet close to the town of Saugatuck. The shore is well cultivated and well wooded, sloping gradually to the lake from heights of 60 to 120 feet, a mile from shore.

Saugatuck to Holland.—Between Kalamazoo River and Holland lights the shore runs due north with low bluffs and many detached hills from 100 to 250 feet high.

Shoals.—There are no shoals more than $\frac{1}{2}$ mile from shore excepting one detached 18-foot spot half way between the two harbors, $\frac{1}{2}$ mile from shore.

Holland Lights to Grand Haven.—From Holland Lights to Grand Haven the coast curves slightly to the NW. and is less bold and more wooded with a number of low hills, a few rising to a height of 150 feet. To the eastward of Grand Haven light a hill rises to a height of 200 feet $\frac{1}{2}$ mile inland.

Grand Haven to Muskegon.—Between Grand Haven and Muskegon the coast continues the same for half this distance, then comes a succession of small hills from 175 to 200 feet high and close to the shore.

Muskegon to White River.—From Muskegon to White River the coast is a straight line running nearly NW. by W., lined with low bluffs and a few high hills.

White River to Pentwater.—Between White River and Pentwater the shore is a succession of bluffs with prominent clay banks 246 feet high, about 9 ($10\frac{1}{2}$) miles north of White River light. From this point north to a short distance past Little Point Sable light the bluffs are interspersed with numerous hills near the coast, which rise from 150 to 250 feet above the lake level.

North of this light the shore sweeps in to the NE. to Pentwater and is lined with wooded bluffs.

Shoals.—There are no shoals more than $\frac{3}{8}$ mile from shore excepting a small spit 5 miles north of White River light, which extends nearly $\frac{1}{2}$ mile with 14 feet of water on it.

Little Point Sable Light.—A fixed white light, varied by a white flash every 30 seconds, visible $16\frac{1}{4}$ ($18\frac{3}{4}$) miles, is shown from a conical tower connected with a dwelling, both of red brick, on Little Point Sable.

Pentwater to Ludington.—From Pentwater to Ludington the coast trends again slightly to the northward and westward, and is lined with bluffs and hills rising to heights of from 150 to 250 feet.

Ludington to Manistee.—Between Ludington and Manistee the coast is regular and trends to the NW. $\frac{1}{3}$ the distance until, at Big Point Sable, it turns again to the NE. This part of the coast is low for a distance of $1\frac{1}{2}$ miles, but after passing a bluff south of the village of Lincoln it

rises gradually to a height of 120 feet. About $1\frac{1}{4}$ miles east from Big Point Sable light is a hill 60 feet high and NE. of this is one 168 feet high.

North of this the coast is low with one or two elevations of 60 feet as Manistee is approached.

Big Point Sable Light.—A fixed white light, visible $16\frac{1}{4}$ ($18\frac{3}{4}$) miles, is shown from a conical tower, connected with a dwelling, both of yellow brick, on Big Point Sable.

Life-Saving Station.—There is a Life-Saving Station one mile south of this lighthouse.

Manistee to Portage Lake.—From Manistee to Portage Lake there are a number of hills about a mile apart and from 60 to 180 feet high.

Portage Lake to Frankfort.—Between Portage Lake and Frankfort there are many high hills close to the coast. About 4 miles north of Portage Lake is one 322 feet high, and 4 miles further on one 349 feet high, and 4 miles further north is one 400 feet high.

South of Frankfort light is an elevation of 265 feet, and north of it one of 323 feet.

From this point to Point Betsey where the coast line turns to the NE. the shore is low.

Chicago to Traverse City.—From the point of departure $1\frac{3}{4}$ ($2\frac{1}{8}$) miles east of Chicago Pierhead light, head N. by E. $\frac{5}{8}$ E. (N. $18^{\circ} 16'$ E.) for 176 ($202\frac{1}{2}$) miles, when, Point Betsey light bearing abeam and distant $3\frac{9}{10}$ ($4\frac{1}{2}$) miles, head NE. $\frac{1}{2}$ N. (N. $39^{\circ} 23'$ E.) for $21\frac{9}{10}$ ($25\frac{1}{4}$) miles when South Manitou Island light should bear abeam distant 3 ($3\frac{1}{2}$) miles. From here shape course for $23\frac{1}{2}$ (27) miles NE. $\frac{3}{8}$ E. (N. $49^{\circ} 13'$ E.) until Grand Traverse light bears ESE. $\frac{1}{8}$ E. (S. $68^{\circ} 54'$ E.), when run east for $4\frac{3}{4}$ ($5\frac{1}{2}$) miles. The light should now bear SW. by W. $\frac{3}{4}$ W. (S. $64^{\circ} 41'$ W.) distant $2\frac{4}{10}$ ($2\frac{3}{4}$) miles, from which point a course S. by W. (S. $11^{\circ} 15'$ W.) should carry clear of all dangers to the anchorage off the city $28\frac{2}{10}$ ($32\frac{1}{2}$) miles distant.

LIGHTS AND FOG SIGNALS.

Point Betsey (aux Becs Scies) Light is a flashing white light every 10 seconds, visible $12\frac{8}{10}$ ($14\frac{3}{4}$) miles. It is shown from a yellow cylindrical tower, connected with a yellow dwelling with a red roof.

Fog Signal.—A steam whistle near the tower sounds blasts of 5 seconds duration with alternate silent intervals of 10 and 40 seconds.

South Manitou Light.—A fixed white light is here shown from a conical white tower, connected with a yellow dwelling. It is visible 16 ($18\frac{3}{4}$) miles.

Fog Signal.—A steam whistle in a house 34 feet NE. (N. 45° E.) from South Manitou light sounds blasts of 8 seconds duration with silent intervals of 52 seconds.

Grand Traverse Light.—Fixed white, visible $11\frac{7}{10}$ ($13\frac{1}{2}$) miles, is shown from a square tower on a yellow dwelling on the NW. extremity of Lighthouse Point.

Mission Point Light.—Fixed white, visible $12\frac{1}{10}$ (14) miles, is shown from a square tower on a white dwelling on the NE. point of the peninsula dividing Grand Traverse Bay.

Life-Saving Station.—There is a Life-Saving Station 550 yards south of the lighthouse on Point Betsey.

From Point Betsey to Sleeping Bear Point the shore is bold, rising at several points into high bluffs. It can be approached to $\frac{1}{4}$ mile except at Platte River Point where a spit extends to the north for $\frac{3}{4}$ mile having but 6 feet of water on it, deepening to 13 and 16 feet $\frac{1}{2}$ and $\frac{3}{4}$ mile further out. At the foot of Empire Bluffs there is a depth of 16 feet $\frac{3}{8}$ mile from shore.

Between Sleeping Bear Point and Pyramid Point a rocky shoal with but 9 feet of water on it extends $\frac{3}{4}$ mile to the northward of Glen Arbor.

Shoals.—From $\frac{3}{4}$ to one mile north of Pyramid Point are two 15-foot spots. Elsewhere there are no shoals more than $\frac{1}{4}$ mile from shore.

To the eastward of Pyramid Point there is good anchorage, and protection from southerly winds in Good Harbor Bay off North Unity.

The eastern side of this bay is full of shoals with but 7 to 8 feet over them.

North of Carp River Point the shore is bluff and wooded, with shoals extending $\frac{1}{2}$ mile from shore.

Four miles NE. $\frac{1}{2}$ N. ($N. 39^{\circ} 22' E.$) from the dock at Carp River landing and $1\frac{1}{3}$ ($1\frac{3}{8}$) miles from shore are several rocky patches with 12 to 16 feet over them.

Three-fourths mile NW. of Cat Head Point is a 16-foot spot.

Between Cat Head and Lighthouse points two shoals extend $\frac{3}{4}$ mile, besides a 15-foot detached spot $\frac{7}{8}$ mile east of Cat Head.

South Manitou Island.—A harbor on the eastern side of the island affords good anchorage. The island can be approached to $\frac{1}{3}$ mile except on the southern and southwestern sides where shoal water extends $\frac{1}{2}$ to $\frac{3}{4}$ mile from shore. There is a rock with 3 fathoms of water over it SSW. $\frac{1}{2}$ W. ($S. 28^{\circ} 08' W.$) $1\frac{7}{8}$ ($2\frac{1}{8}$) miles from the SW. point of the island.

North Manitou Island.—This island can be safely approached to $\frac{1}{4}$ mile on the north shore and $\frac{1}{2}$ mile on the east and west shores, but a rocky spit extends more than $\frac{3}{4}$ mile to the southward from the SW. point.

Life-Saving Station.—Near Pickards wharf, east side of the island.

South Fox Island is NNE. of North Manitou Island, distant $15\frac{2}{10}$ ($17\frac{1}{2}$) miles. It is $4\frac{1}{2}$ ($5\frac{1}{8}$) miles long NW. and SE. and $1\frac{1}{3}$ ($1\frac{1}{2}$) miles wide, tapering to a point at the NW. and SE. extremities. The western coast consists of bluffs and hills, the eastern side being low.

South Fox Island Light.—A fixed red light, varied by a red flash every 2 minutes, visible $13\frac{2}{10}$ (16) miles, is shown from a square yellow tower attached to a yellow dwelling on the southern extremity of the island.

Shoals.—From the island a bank with from 4 to 8 fathoms of water over it extends south $8\frac{1}{2}$ ($9\frac{1}{2}$) miles, varying in width from $1\frac{1}{4}$ to $1\frac{3}{4}$ miles, with depths of 20 to 30 fathoms outside. On this bank there are several small shoals.

A shoal spot, 11 feet of water over rocks, bears S. by W. (S. $11^{\circ} 15' W.$) from the light, distant 4 ($4\frac{1}{2}$) miles.

Buoy.—A red and black horizontally striped nun buoy marks the south side of this shoal, which extends $\frac{1}{2}$ mile north and south. The bottom near the buoy is rocky, the soundings irregular, and vessels must be careful in this vicinity in thick weather.

A shoal spot with 16 feet of water over it lies S. $\frac{1}{2}$ W. (S. $5^{\circ} 37' W.$) distant $6\frac{1}{2}$ ($7\frac{1}{2}$) miles from the light.

Buoy.—A red and black horizontally striped can buoy marks the south end of this shoal. It is in 20 feet of water.

Two other spots S. $\frac{1}{4}$ W. (S. $8^{\circ} 26' W.$) $6\frac{2}{10}$ ($7\frac{1}{2}$) miles from the light have 12 feet over them.

Buoy.—A red and black horizontally striped spar buoy marks the south side of the NW. spot. It is moored in 17 feet of water.

Caution.—In thick weather vessels should not shoal the water to less than 5 fathoms in this vicinity.

Around the south end of the island shoals extend $\frac{1}{2}$ mile off shore, and off the NW. end there is shoal water for $\frac{1}{2}$ mile, terminating in a narrow spit off the NW. point which extends $1\frac{1}{4}$ miles to the NW.

North Fox Island.—Four miles NE. of South Fox Island is North Fox Island, $2\frac{1}{2}$ miles long NNW. and SSE. and one mile wide at the NW. end, tapering to a point at the SE. end.

Shoals.—Shoal water extends $\frac{1}{2}$ mile from the east and north shores and $\frac{3}{4}$ mile from the west shore.

North of Lighthouse Point a rocky spit extends $\frac{1}{2}$ mile with 12 feet of water at the outer end.

From here, to a point one mile north of Northport Point, the shore may be safely approached not nearer than $\frac{1}{2}$ mile. Three-fourths mile north of Northport Point is a rocky spit extending southeasterly $\frac{1}{2}$ mile with 9 feet of water on the outer end. Two dangerous shoals lie between Northport Point and Northport; a small 8-foot shoal near the middle of Northport Bay and a 6-foot shoal $\frac{3}{4}$ mile long north and south is $\frac{3}{4}$ mile NE. from it.

Northport is a well-sheltered harbor.

Bellows Island.—This small island lies $2\frac{1}{2}$ miles S. by W. from Northport Point, and shoal water extends $\frac{1}{2}$ mile north and east from it.

South of Bellows Island and extending $\frac{3}{4}$ mile N. by E. from the northern point of New Mission Point is a rocky shoal with 15 feet of water over it. From that point on to Pishaubys Village the coast is regular, but should not be approached within $\frac{1}{2}$ mile.

Doughertys Harbor.—This harbor, under New Mission Point, affords good anchorage

Suttons Bay, to the southward and westward, is a good harbor; its western shore is shoal for $\frac{1}{2}$ mile. Off Suttons Point a rocky spit extends $\frac{3}{8}$ mile to the northward with 14 feet of water on the northern end.

Half way between this point and Lees Point a flat begins and extends south to Lees Point extending east $\frac{1}{2}$ mile and southward from the point for $\frac{3}{4}$ mile.

From Lees Point south the coast is free from dangers until 2 miles north of the dock at Traverse City, where a dangerous 9-foot spit extends $\frac{5}{8}$ mile from shore.

On the east side of the west arm a dangerous rocky flat extends from Old Mission Point north and west $1\frac{3}{4}$ miles from shore, with 10 feet of water on the NW. end.

From Old Mission Point to Tuckers Point several spits extend from the shore, making navigation unsafe within $\frac{1}{2}$ mile. From Tuckers Point a rocky spit extends south for $\frac{1}{2}$ mile, with only 5 feet of water on the extremity.

Hog Island.—There is a rocky spit extending from the south point for $\frac{3}{4}$ mile to the SW. with 11 feet of water on it, and a smaller one NE. from its northern point. This island lies near the course and must not be approached too close.

Bowers Harbor, inside of Tuckers Point, affords good anchorage, and its shores can be approached to $\frac{1}{2}$ mile.

From here to Traverse City the coast is regular, shoal water extending $\frac{1}{2}$ mile.

In the eastern arm of Grand Traverse Bay the west shore can be safely approached to 1,000 feet, except $\frac{1}{2}$ mile south of Old Mission Village, where a flat extends 1,500 feet into the bay. From the point opposite and east of the village a spit extends SE. There is good anchorage off this town in 6 fathoms.

The east shore, from the mouth of the bay to the foot of the arm, has many detached rocky spots and ledges and numerous spits extending from the shore, but none more than $\frac{3}{4}$ mile, excepting a point $3\frac{3}{4}$ ($4\frac{1}{4}$) miles E. by N. (N. $78^{\circ} 45'$ E.) from Old Mission Point, where there is a detached 15-foot spot one mile from shore, and at the head of the arm, where shoal water extends $1\frac{1}{2}$ miles.

Chicago to Charlevoix.—Steer as in the preceding case (Chicago to Traverse City) until Grand Traverse light bears ESE. $\frac{1}{2}$ E. (S. $68^{\circ} 54'$ E.),

when head NE. by E. $\frac{3}{4}$ E. (N. $64^{\circ} 41'$ E.) until Charlevoix light bears abeam, distant $1\frac{1}{4}$ (2) miles, when head in for the piers.

Fishermans Island is a small island $\frac{1}{2}$ mile off shore, and is surrounded by exposed rocks and extensive shoals.

Shoals.—A 12-foot shoal extends $\frac{3}{8}$ mile north, an 11-foot shoal $\frac{5}{8}$ mile NW., and about the same depth is found $\frac{3}{8}$ mile to the westward of this island, while shoals connect it with the shore. One and one-half miles SW. by W. (S. $56^{\circ} 15'$ W.) are two 18-foot spots.

From this point to Charlevoix there are no shoals more than $\frac{1}{3}$ mile from shore. The coast is lined with exposed rocks, and low bluffs rise a short distance back from the shore. On the point NE. of Charlevoix is a small prominent hill.

Chicago to Little Traverse.—Steer as directed to Charlevoix, continuing the course NE. by E. $\frac{3}{4}$ E. (N. $64^{\circ} 41'$ E.) until the light on the point near Harbor Springs bears E. by N. (N. $78^{\circ} 45'$ E.), when bring the light a little on the port bow and stand in.

This is a well-sheltered harbor.

Between Charlevoix and Little Traverse the coast line is bold, with several prominent hills.

Shoals.—There are no shoals more than $\frac{1}{4}$ mile from shore after passing Big Rock Point until the SE. end of Little Traverse Bay is reached, where is a 16-foot shoal $\frac{1}{2}$ mile from shore. At the NE. end of the bay there is a 14-foot shoal $\frac{1}{2}$ mile from shore. From that point along the shore to a point one mile west of the lighthouse there are no shoals more than $\frac{1}{4}$ mile from shore.

FROM CHICAGO TO THE STRAITS OF MACKINAC AND MACKINAC CITY

Steer as directed until off Point Betsey, then head NE. $\frac{1}{2}$ N. (N. $39^{\circ} 23'$ E.) for 86 (99) miles, which will carry to a point $\frac{3}{4}$ mile N. $\frac{1}{4}$ W. (N. $2^{\circ} 49'$ W.), off Waugoshance lighthouse. Keep a sharp lookout for Vienna and Rose Shoal buoys.

Note.—For vessels of deep draft, when Ile aux Galets light bears abeam to starboard, head N. by E. $\frac{3}{4}$ E. (N. $19^{\circ} 41'$ E.) until close to White Shoal lightvessel, when keep away to the eastward.

From the point off Waugoshance lighthouse head east until well past Old Point Mackinac light, when stand down for the anchorage off Mackinac City, or shape course for passage through the straits.

For courses from this point, see chapter on the Straits of Mackinac and the sailing directions for the other lakes.

From Little Traverse Bay the coast extends north and then NE., with high bluffs until 4 miles south of Waugoshance Point.

Shoals.—For this distance, with the exception of Ile aux Galets shoals, there are no shoals more than $\frac{3}{4}$ mile from shore.

Ile aux Galets.—This is a rock $5\frac{1}{2}$ miles off shore and $7\frac{1}{2}$ ($8\frac{1}{2}$) miles SSW. $\frac{3}{4}$ W. (S. $26^{\circ} 43'$ W.) from Waugoshance lighthouse.

Skulligallee (Ile aux Galets), a fixed white light, visible $13\frac{3}{10}$ ($15\frac{1}{4}$) miles, is shown from an octagonal tower connected with a white dwelling on Ile aux Galets.

Fog Signal.—A steam whistle in a building near the tower sounds blasts of 5 seconds duration with alternate silent intervals of 10 and 40 seconds.

Reef.—A reef extends from the light NW. by W. $\frac{1}{4}$ W. (N. $59^{\circ} 04'$ W.) $\frac{1}{4}$ mile, with 5 feet of water near the outer end, and one extends NE. by E. $\frac{3}{4}$ E. (N. $60^{\circ} 28'$ E.) $1\frac{1}{4}$ ($1\frac{1}{2}$) miles, with 14 feet of water on its outer end.

Buoy.—A black nun buoy marks the end of the NW. reef.

Caution.—Keep to the westward of the buoy.

Off the end of Waugoshance Point, a low, narrow strip, lies Waugoshance Island, 4 miles from the mainland, and $1\frac{1}{2}$ miles NW. of the island is Waugoshance light.

Extensive shoals connect all of these.

Waugoshance Light is a fixed white light, varied by a white flash every 45 seconds, visible $14\frac{1}{4}$ ($16\frac{1}{2}$) miles. It is shown from a tower attached to a dwelling on a square crib at the NW. end of Waugoshance shoal, $1\frac{1}{4}$ miles NW. of Waugoshance Islands. The buildings are painted in red and white horizontal bands, and below the lower edge of the roof only white.

This light marks the turning point between Lake Michigan and the Straits of Mackinac when keeping inside of Beaver Island.

Fog Signal.—A steam whistle in a house near the light gives blasts of 5 seconds duration with silent intervals of 25 seconds.

Shoals.—Waugoshance shoal extends $\frac{1}{4}$ mile west and $1\frac{1}{2}$ miles south of the light. It extends $\frac{3}{4}$ mile to the westward with 15 feet of water on its SW. end. From here it stretches SE. by E. $8\frac{1}{2}$ miles, varying in width from 2 to $2\frac{1}{2}$ miles, including Waugoshance Island and several other detached portions off Waugoshance Point.

Waugoshance Island is one mile long east and west, and $\frac{1}{4}$ mile wide, and can be approached to $\frac{1}{4}$ mile on the south side.

Caution.—Keep to the westward of a line joining Ile aux Galets and Waugoshance lights.

Rose Shoal (Waugoshance Sixteen Foot Shoal).—This is a small shoal, gravel and boulders, $1\frac{1}{2}$ miles NW. of Waugoshance lighthouse with 16 feet of water on it. Distant $1\frac{1}{4}$ miles N. by W. $\frac{1}{8}$ W. (N. $12^{\circ} 39'$ W.) from the light is an 18-foot spot.

There may be less than 20 feet between these two spots.

Buoy.—A black nun buoy marks the 16-foot shoal, and its position is fixed by the intersection of two ranges, one between Waugoshance light and White Shoal lightvessel, and the other between St. Helena light and Gray Reef lightvessel. These lines may be serviceable at night.

Vienna Shoal.—This is a small 13-foot rocky shoal with boulders near the center, WSW. $\frac{1}{2}$ W. (S. $73^{\circ} 07'$ W.) $1\frac{1}{2}$ ($1\frac{1}{2}$) miles from Waugoshance light, extending 300 yards east and west and 175 yards north and south. Keep at least $\frac{3}{8}$ mile off the buoy.

Buoy.—A red and black horizontally striped can buoy marks this shoal.

Twenty One Foot Spots.—One mile SE. by E. from this shoal is a small 21-foot spot, and one mile E. by N. of the same shoal is another spot, making the passage between Vienna shoal and Waugoshance light dangerous for deep-draft vessels.

Grays Reef.—This is a part of the extensive rocky shoal surrounding and extending east from Hat and Hog islands.

Lightvessel.—Grays Reef lightvessel, No. 57, a two-masted schooner, shows a fixed white light visible $11\frac{1}{2}$ miles, and a fixed red light visible $8\frac{1}{2}$ miles, with daymarks on the mastheads, black on the fore, and red on the main. This vessel is moored in 20 feet of water off the easterly end of Grays reef, $4\frac{1}{4}$ ($4\frac{1}{4}$) miles west of Waugoshance lighthouse and N. $\frac{1}{2}$ W. (N. $5^{\circ} 37'$ W.) $6\frac{1}{2}$ ($7\frac{1}{2}$) miles from Ile aux Galets light.

Caution.—Do not pass to the westward of the lightvessel.

Fog Signal.—A steam whistle on this vessel sounds blasts as follows: Blast 3 seconds, silent intervals 10 seconds; blast one second, silent interval 10 seconds; blast one second, silent interval 35 seconds.

White Shoal.—NW. from Waugoshance lighthouse, distant 4 ($4\frac{1}{2}$) miles, is a shoal extending $\frac{3}{4}$ mile NE. and SW. with 3 feet of water near its SW. end and 18 feet near its NE. end.

Buoy.—A red and black horizontally striped spar buoy marks the SW. end of White Shoal.

Lightvessel.—White Shoal lightvessel, No. 56, a two-masted schooner, shows 2 fixed white lights, each from a group of 3 lens lanterns encircling the masthead, visible $9\frac{1}{4}$ ($11\frac{1}{4}$) miles with black daymarks at each masthead. It is moored in 26 feet of water $3\frac{1}{2}$ ($4\frac{1}{2}$) miles NW. by N. (N. $33^{\circ} 45'$ W.) from Waugoshance lighthouse.

Fog Signal.—A steam whistle on board sounds as follows: Blast one second, silent interval 10 seconds; blast one second, silent interval 10 seconds; blast 3 seconds, silent interval 35 seconds.

NNE. $\frac{1}{2}$ mile from the lightvessel is a 21-foot spot.

Simmons Reef.—NW. by N. (N. $33^{\circ} 45'$ W.) 5 ($5\frac{1}{2}$) miles from White Shoal lightvessel is Simmons Reef lightvessel, and $\frac{3}{4}$ mile north of the lightvessel is the reef extending $1\frac{1}{2}$ miles east and west and $\frac{1}{4}$ mile north and south with 6 feet of water on shoalest spot.

Lightvessel.—Simmons Reef lightvessel, No. 55, a two-masted schooner, shows 2 fixed red lights, each from a group of 3 lens lanterns encircling the masthead, visible $8\frac{1}{2}$ miles, with red daymarks at each masthead. This lightvessel is moored in 19 feet of water and is nearly on a line with Waugoshance light and White Shoal lightvessel.

Fog Signal.—A steam whistle as follows: Blast one second, silent interval 10 seconds; blast 3 seconds, silent interval 10 seconds; blast one second, silent interval 35 seconds.

ISLANDS.

A group of islands lies to the westward and southwestward of Waugoshance light. This group, with the shoals, extends $17\frac{1}{2}$ (20) miles north and south and 26 (30) miles east and west.

Beaver Island is the most southern as well as the largest of this group. It is 13 miles long north and south, $6\frac{1}{2}$ miles broad at its southern end, and $3\frac{1}{4}$ miles broad at its northern end. It is well wooded, with low bluffs on the east side and higher hills on the west side. At the NE. end is Beaver Harbor, a small but well-sheltered anchorage.

Beaver Island Light.—On the south end of Beaver Island, a fixed, white light, varied by a white flash every minute, visible 16 ($18\frac{1}{2}$) miles, is shown from a cylindrical tower on the west end of a dwelling, both yellow. This is a coast light and a guide between Beaver and North Fox islands.

Fog Signal.—A steam siren sounds blasts of 7 seconds duration with silent intervals of 42 seconds.

Shoals.—Shoal water extends $\frac{1}{2}$ to $\frac{3}{4}$ mile from shore around the island, excepting the middle of the eastern side, where the shore can be approached to $\frac{1}{4}$ mile. A 10-foot shoal extends one mile NW. from the NW. end and a 4-foot spot $\frac{5}{8}$ mile NNE. from the NE. point.

Buoy.—A black spar buoy marks the outer end of this latter shoal. The buoy is 1,100 yards from shore.

Detached 16 and 17-foot spots lie east and SE. of this buoy.

Beaver Island Harbor.—The deep water in this harbor extends $\frac{5}{8}$ mile NW. and SE. and $\frac{1}{4}$ mile NE. and SW. The entrance is very narrow, rendering it difficult for large vessels or those unacquainted with the harbor to enter.

Light.—Beaver Island Harbor light, a fixed red light, visible $11\frac{1}{4}$ (13) miles, is shown from a cylindrical tower attached to the south end of a dwelling, both white, on the north side of the entrance to the harbor.

Life-Saving Station.—There is a Life-Saving Station 165 feet west of the lighthouse.

Shoals.—On the north side of the entrance an 11-foot shoal extends east $\frac{3}{4}$ mile, its south edge being $\frac{1}{8}$ mile south of the lighthouse.

Fifteen Foot Detached Spot.—Two miles E. by N. from the light is a 15-foot spot.

Caution.—Keep a lookout for the shoal on the north side of the entrance.

Directions for Entering.—With the lighthouse bearing NW. by W. distant one mile, bring it a little on the starboard bow and head NW. by W. $\frac{3}{4}$ W. (N. $64^{\circ} 41'$ W.) into the harbor. Give the lighthouse a berth of at least 200 yards. Good anchorage can be found on a line between the inner and outer docks.

Garden Island.—This island, 5 miles long NW. and SE. and 2 to $2\frac{1}{2}$ miles broad, lies north from Beaver Island and $1\frac{3}{8}$ miles distant at the nearest point. It is generally wooded and low and surrounded by exposed rocks and rocky shoals and reefs.

Shoals.—On the east side extensive shoals $3\frac{3}{4}$ miles wide connect this island with Hog Island. These extend around the south and west sides, 7 feet of water being found in spots $2\frac{1}{2}$ miles SW. of the island.

The north side of the island for a distance of 3 miles can be approached to $\frac{3}{8}$ mile.

Garden Island Shoal is a small 15-foot spot $2\frac{1}{2}$ ($2\frac{3}{4}$) miles north of the island.

Buoy.—A red and black horizontally striped spar buoy marks the center of this shoal.

Hog Island lies $3\frac{1}{2}$ (4) miles east of Garden Island and is $3\frac{1}{2}$ miles long north and south and from one to $1\frac{1}{2}$ miles in width. It is wooded and low.

Shoals.—Shoal water extends one mile NW. of this island and $1\frac{1}{2}$ miles SW. of it.

Shoals extend east, being 5 miles wide north and south near the island, and gradually decreasing in width to a point at Grays Reef lightvessel, 7 (8) miles distant.

Hog Island Reef lies $3\frac{1}{2}$ miles SSE. from Hog Island. It is $\frac{3}{8}$ mile long east and west and 220 yards wide, with 5 feet of water on its western end.

Buoy.—A red and black horizontally striped can buoy marks the SE. end of this reef.

Hat Island.—East of the north end of Hog Island, distant $2\frac{1}{2}$ ($2\frac{3}{4}$) miles, is this small island about $\frac{1}{4}$ mile square.

Rock.—There is an exposed rock $\frac{1}{2}$ mile to the southward, and shoals extend $\frac{3}{8}$ mile northward and eastward of this island.

High Island.—West of the north end of Beaver Island, 4 miles distant, is High Island, $3\frac{1}{2}$ miles long north and south, 3 miles wide at the north end, and $1\frac{1}{4}$ miles wide at the south end. The island has a few small hills on the west and NE. sides and is sparsely wooded. Exposed rocks

skirt the coast to the south and NW. and shoals extend from $\frac{1}{2}$ to $\frac{7}{8}$ mile from shore. At the NE. end 5 feet of water is found $1\frac{1}{8}$ miles from shore.

Halfway between High and Trout islands is a 12-foot spot.

Trout Island.—This small island, $\frac{1}{2}$ mile in extent east and west and $\frac{3}{8}$ mile north and south, lies north of High Island and is surrounded by shoals extending $\frac{1}{4}$ to $\frac{1}{2}$ mile from shore.

Eighteen Foot Detached Spot.—Two miles W. $\frac{1}{2}$ N. (N. $84^{\circ} 23'$ W.) from Trout Island is an 18-foot detached spot.

Whiskey Island.—West of Garden Island is Whiskey Island, about $\frac{3}{8}$ mile square, with a small hill on the western side.

Shoals.—Rocky shoals extend from this island one mile to the eastward, $\frac{1}{2}$ mile to the westward, and $\frac{3}{8}$ mile to the northward and southward. Between this and Garden Island are numerous detached 14 and 17-foot spots.

Whiskey Island Shoal.—This shoal has a spot just awash, $1\frac{1}{4}$ miles SW. of Whiskey Island, and from this point it extends one mile east, $\frac{1}{2}$ mile north and west, and $\frac{1}{4}$ mile south.

Buoy.—A red spar buoy marks the south end of this shoal.

Squaw Island.—This small island lies $1\frac{1}{2}$ ($1\frac{3}{4}$) miles NNE. (N. $22^{\circ} 30'$ E.) of Whiskey Island, and is $\frac{1}{2}$ mile long north and south, $\frac{3}{8}$ mile wide at its north end, and tapers to a point at the south end. It is low and partly wooded.

Squaw Island Light.—A fixed red light varied by a red flash every 15 seconds, visible 13 (15) miles, is shown from an octagonal tower attached to a dwelling, both red, on the north end of Squaw Island.

Fog Signal.—A steam whistle sounds blasts of 5 seconds duration with alternate silent intervals of 20 and 40 seconds.

Shoals.—Shoals extend $\frac{1}{2}$ mile to the westward, $\frac{3}{4}$ mile to the north, south, and east, and a 16-foot spit extends $1\frac{1}{4}$ miles NE. There is a detached 13-foot spot $1\frac{1}{2}$ miles east of the south end of the island.

Squaw Island Shoal Buoy.—A black nun buoy marks the north end of the shoal extending to the northeastward from Squaw Island, and is $1\frac{1}{4}$ (2) miles NNE. (N. $22^{\circ} 30'$ E.) from the light.

Lansing Shoal.—Four and one-tenth ($4\frac{1}{10}$) miles north of Squaw Island is Lansing shoal, with a $19\frac{1}{2}$ -foot spot 700 yards NW. $\frac{1}{2}$ W. (N. $50^{\circ} 38'$ W.) from the buoy and a 23-foot spot 1500 yards W. $\frac{3}{4}$ N. (N. $81^{\circ} 34'$ W.) from the same buoy.

Buoy.—A red nun buoy marks the SE. end of the shoal. It is $4\frac{1}{4}$ ($4\frac{7}{8}$) miles N. $\frac{1}{4}$ E. (N. $9^{\circ} 51'$ E.) from Squaw Island light.

Gull Island.—This island lies $5\frac{3}{8}$ ($6\frac{1}{2}$) miles west of the south end of High Island and is $1\frac{3}{8}$ miles long, north and south, and $\frac{3}{8}$ mile wide. Its shore is lined with low bluffs and it is partly wooded.

Shoals.—Shoals extend nearly $\frac{1}{2}$ mile off this island, and a 16-foot spit extends SSE. for one mile.

Gull Island Reef.—This reef is $3\frac{1}{2}$ (4) miles SSE. (S. $22^{\circ} 30'$ E.) of Gull Island. It is about $\frac{1}{2}$ mile in length, NE. and SW., and $\frac{3}{8}$ mile NW. and SE., with 6 feet of water near the center. One-half mile to the eastward and southeastward are several detached spots with 16 feet of water on them.

For a description of the coast east of Waugoshance light, see Chapter X.

CHAPTER V.

SAILING DIRECTIONS FROM CHICAGO TO THE PORTS ON THE WEST AND NORTH SHORES.

Stand out of Chicago harbor, steering east from Chicago Pierhead light for $1\frac{1}{8}$ ($2\frac{1}{4}$) miles, then steer as follows:

To—	Courses.	Distance.	Having reached the point given below stand into the harbor.
		<i>Miles.</i>	
Waukegan -----	N. by W. $\frac{3}{8}$ W. (N. $21^{\circ} 06'$ W.)	30 ($34\frac{1}{2}$)	East of light, $1\frac{3}{4}$ (2) miles.
Kenosha -----	N. by W. $\frac{1}{4}$ W. (N. $14^{\circ} 04'$ W.)	43 $\frac{1}{2}$ (50)	Off the entrance, $1\frac{1}{8}$ ($1\frac{1}{2}$) miles.
Racine -----	N. $\frac{3}{8}$ W. (N. $9^{\circ} 51'$ W.)	51 $\frac{1}{4}$ (59)	SE. by E. of Pierhead light, $1\frac{1}{8}$ ($1\frac{1}{2}$) miles.
Milwaukee -----	N. $\frac{5}{8}$ W. (N. $7^{\circ} 02'$ W.)	62 $\frac{1}{2}$ (72)	
	When Milwaukee light bears NW. by N. (N. $33\frac{3}{4}^{\circ}$ W.) head for it.	8 $\frac{3}{8}$ (10)	East of Pierhead light, $2\frac{1}{8}$ (3) miles.
Port Washington -----	N. $\frac{5}{8}$ W. (N. $7^{\circ} 02'$ W.)	90 $\frac{3}{4}$ (104 $\frac{1}{2}$)	Off the entrance, distant 3 ($3\frac{1}{2}$) miles.
Sheboygan -----	W. $\frac{1}{8}$ N. (N. $1^{\circ} 24'$ W.)	113 $\frac{3}{4}$ (131)	On range of lights, distant 2 ($2\frac{1}{2}$) miles.
Manitowoc -----	N. $\frac{1}{8}$ W. (N. $0^{\circ} 42'$ W.)	134 $\frac{1}{2}$ (155)	Off the entrance, distant $1\frac{1}{8}$ ($1\frac{1}{2}$) miles.
Two Rivers -----	North	136 $\frac{1}{8}$ (157)	Do.
Kewaunee -----	N. $\frac{1}{8}$ E. (N. $1^{\circ} 24'$ E.)	153 (176 $\frac{1}{4}$)	On range of lights, distant 3 ($3\frac{1}{2}$) miles.
Ahnapee -----	N. $\frac{1}{8}$ E. (N. $1^{\circ} 24'$ E.)	162 (186 $\frac{1}{2}$)	On range of lights, distant $1\frac{1}{8}$ ($1\frac{1}{2}$) miles.
Sturgeon Bay Canal -----	N. $\frac{3}{8}$ E. (N. $4^{\circ} 13'$ E.)	174 (200 $\frac{1}{2}$)	Off the entrance, $1\frac{1}{8}$ ($1\frac{1}{2}$) miles.
Bailey Harbor -----	N. $\frac{5}{8}$ E. (N. 7° E.)	190 $\frac{3}{8}$ (219 $\frac{1}{2}$)	On range of lights, distant $3\frac{1}{8}$ (4) miles.
Manistique -----	N. by E. $\frac{1}{4}$ E. (N. $14^{\circ} 04'$ E.)	249 (286 $\frac{3}{4}$)	Off the entrance, $1\frac{1}{8}$ ($1\frac{1}{2}$) miles.

Chicago to Grossepoint (Evanston, Illinois).—The coast is low.

Shoals.—Shoals extend $\frac{1}{2}$ to $\frac{5}{8}$ mile from shore at several points, and east of Grossepoint a 16-foot shoal extends $\frac{5}{8}$ mile from shore. Less than 20 feet is found one mile from shore. Keep at least $1\frac{1}{2}$ miles from shore when passing this point.

Grossepoint Light.—A fixed white light, varied by a red flash every 3 minutes and visible 17 ($19\frac{1}{2}$) miles, is shown from a conical tower connected with a dwelling on Grossepoint; both are yellow with red roofs.

Fog Signal.—A steam whistle in a building east of the tower sounds blasts of 5 seconds duration with alternate silent intervals of 20 and 40 seconds.

Life-Saving Station.—There is a Life-Saving Station $\frac{3}{4}$ mile south of the lighthouse.

Grossepoint to Waukegan, Illinois.—The coast is low and wooded, with numerous small towns along it. Shoal water extends $\frac{1}{2}$ to $\frac{3}{8}$ mile from shore.

Waukegan to Kenosha, Wisconsin.—The coast is low and wooded. Shoal water extends $\frac{1}{2}$ to $\frac{3}{8}$ mile from shore.

Kenosha to Racine, Wisconsin.—The coast is low and safe to $\frac{1}{2}$ mile off shore until off Racine, where there is an extensive reef.

Racine Reef is 2 miles from shore with an 8-foot spot ESE. $\frac{1}{2}$ E. (S. $73^{\circ} 08'$ E.) $1\frac{1}{8}$ ($1\frac{1}{8}$) miles from Racine Pierhead light. There are one or two 16-foot spots $\frac{1}{2}$ mile north of the reef, and also one 14-foot spot $\frac{1}{4}$ mile north of it.

Buoys.—A black can buoy marks the western edge of this reef which extends one mile ENE. and WSW. It is $\frac{3}{8}$ mile wide north and south, the eastern edge being marked by a red spar buoy. The shoalest spot is midway between the buoys. Between the reef and the harbor there is from 3 to 6 fathoms of water.

Wind Point (Racine Point) Light.—A flashing white light every 30 seconds, visible $16\frac{1}{2}$ (19) miles, is shown from a conical yellow tower connected with a yellow dwelling on Wind Point $3\frac{1}{2}$ miles northward of Racine lighthouse.

A fixed red light, visible $7\frac{1}{2}$ ($8\frac{1}{2}$) miles, is shown from the watchroom window immediately under the main light. It illuminates an arc of $19^{\circ} 41'$ between the bearings north and N. by W. $\frac{1}{4}$ W., covering Racine reef.

Fog Signal.—A steam whistle in a building in front of the lighthouse gives alternate blasts of 3 and 5 seconds' duration, with silent intervals of 26 seconds.

Racine to Milwaukee, Wisconsin—Racine Light (Root River).—A fixed white light, visible $12\frac{1}{4}$ ($14\frac{1}{4}$) miles, is shown from a square yellow tower attached to a yellow dwelling. It is on the north pier. Keeping this light open north of the Red Pierhead light insures the passage north of Racine reef.

North of Racine, Wind Point makes out. The coast north of this is bold, the hills $\frac{1}{2}$ mile from the shore rising to heights of 100 to 150 feet.

The coast line trends to the NW., then north to Milwaukee Bay. Do not approach closer than $\frac{1}{2}$ mile. When 8 miles south of Milwaukee Pierhead light, keep at least one mile offshore until off the harbor. Six miles south of this light a hill, close to the coast, rises to a height of 159 feet.

Shoals.—Southeast of the Pierhead light shoals, with 14 to 15 feet of water over them, extend more than $\frac{3}{4}$ mile from shore.

Milwaukee to Port Washington.—North of Milwaukee for some distance the coast is bold and trends nearly north and south, Whitefish Bay being the only considerable indentation. For 6 or 7 miles each side of Port Washington the land is the highest on the west shore.

North of Milwaukee breakwater is the Waterworks Bridge Pier, and north of that the new waterworks crib.

Shoal.—Keep at least $\frac{1}{2}$ mile off the coast as far as Fox Point; here an 8-foot spit extends $\frac{3}{4}$ mile from the shore, and $3\frac{1}{2}$ miles further north a 13-foot spit nearly $\frac{3}{4}$ mile. North of this the coast can be approached to $\frac{1}{2}$ mile for 4 miles, when a 16-foot spot is found between $\frac{1}{2}$ and $\frac{3}{4}$ mile from shore. North of this, shoal water extends $\frac{1}{2}$ mile from shore, and 5 miles south of Port Washington light a 10-foot shoal $\frac{5}{8}$ mile. Back of this a hill rises to a height of 170 feet $\frac{1}{2}$ mile from the coast.

From this point to the entrance to the harbor the shore can be approached not nearer than $\frac{1}{2}$ mile.

Milwaukee Light.—A fixed white light, varied by a white flash every 45 seconds and visible $16\frac{4}{10}$ ($19\frac{2}{5}$) miles, is shown from a brown octagonal tower connected with a white dwelling. It is on the extreme north point of Milwaukee Bay.

Port Washington to Sheboygan, Wisconsin.—The coast is bold, the hills near the coast varying from 60 to 120 feet in height, are wooded. The water is deep $\frac{1}{2}$ mile from shore.

Port Washington Light.—A fixed white light, visible $16\frac{1}{2}$ (19) miles, is shown from a square tower on a yellow dwelling. It is on a bluff north of the town.

Reef.—North of the entrance to the harbor ($\frac{1}{2}$ mile north of the course on which vessels should run in) is a 6-foot reef 600 feet long north and south. It is SE. from Sheboygan light $\frac{1}{2}$ mile and is marked by red buoys.

Buoys.—A red can buoy moored in 24 feet of water marks the south end of the reef.

A red can buoy marks the NE. end of the reef. Least depth of water between the buoys is 7 feet. There is a 17-foot spot north of the reef.

Between the reef and the land there is a narrow passageway 300 feet wide, but this should not be attempted by strangers.

Sheboygan to Manitowoc, Wisconsin—Sheboygan Light.—A fixed white light, visible $12\frac{8}{10}$ ($14\frac{4}{5}$) miles, is shown from a square tower on a white dwelling. It is on a point one mile northward from the town.

From a point 4 miles north of this light shoals extend $\frac{3}{4}$ mile off shore for 15 miles. Nine feet is the least depth $\frac{1}{2}$ mile from shore SE. of Centerville.

A 16-foot spot lies S. 14° E. $1\frac{3}{4}$ miles from the Pierhead light at Manitowoc and $\frac{3}{4}$ mile off shore.

Manitowoc to Two Rivers, Wisconsin.—The coast is low and wooded, trending NE. No shoals extend more than $\frac{1}{2}$ mile from shore. There are three 16-foot spots $1\frac{1}{4}$ miles NE. of Manitowoc Pierhead light and $\frac{1}{2}$ to $\frac{3}{4}$ mile from shore.

Two Rivers to Kewaunee, Wisconsin.—From Two Rivers the coast curves to the northward.

Twin River Light is 5 miles from Two Rivers on the extremity of a low, sandy point. It is a fixed white light, varied by a white flash every 30 seconds and visible $16\frac{1}{2}$ (19) miles. It is shown from a conical tower connected with a dwelling; both are white.

Fog Signal.—A steam whistle sounds blasts of 5 seconds duration with alternate silent intervals of 10 and 40 seconds.

The shore is low, sandy, and marshy for 12 miles, with pine barrens to the north, south, and west; clay bluffs form the remainder of the coast to Kewaunee.

Rock.—There are no shoals extending more than $\frac{1}{2}$ mile from the shore. One ($1\frac{1}{2}$) mile SSE. (S. 22° $30'$ E.) from the dock at Deans, a small town $4\frac{1}{4}$ miles south of Kewaunee, is a rock with 3 feet of water on it $\frac{1}{2}$ mile from shore.

Kewaunee to Ahnapee, Wisconsin.—The coast is lined with bluffs 60 feet high the first part of the way, gradually decreasing in height to the northward.

Shoals.—For half the distance there are no shoals over $\frac{1}{2}$ mile from shore. There are dangerous rocks $\frac{1}{8}$ mile north of the entrance to Kewaunee and $\frac{1}{8}$ mile from shore. Halfway to Ahnapee a 13-foot spit extends out for $\frac{5}{8}$ mile. A short distance north of this point flats with 6 to 14 feet of water extend $\frac{5}{8}$ mile from shore to $\frac{1}{2}$ mile from Ahnapee, where the shore can be safely approached to $\frac{1}{4}$ mile.

Ahnapee to Sturgeon Bay Canal, Wisconsin.—This latter is a harbor of refuge, and the village of Portage is north of the entrance.

Between Ahnapee and Portage the coast is lined with hills 60 feet high with prominent clay banks until nearing the canal, when low, wooded ground is seen.

Shoals.—Shoals extend from $\frac{1}{2}$ to $\frac{3}{4}$ mile from shore. One mile east of Ahnapee light is a 17-foot spot $\frac{3}{4}$ mile from shore.

Three miles south of the canal entrance and one mile from shore is a large 14-foot spot with a smaller 14-foot spot $\frac{1}{2}$ mile to the northward and another the same distance to the westward.

South of this there is a 17-foot spot $\frac{3}{4}$ mile from shore.

For a mile southward from the canal entrance the shore can be safely approached to $\frac{1}{2}$ mile.

Portage to Bailey Harbor.—North from the canal entrance the coast is low and wooded.

Shoals.—Three miles north of the canal a shoal extends a mile from the shore with 6 feet of water on it.

Whitefish Point Shoal.—SE. of Whitefish Point is a 13-foot shoal $\frac{7}{8}$ mile from shore.

Buoy.—A red spar buoy in 18-feet of water marks the SE. end of the above shoal.

For a short distance north of this there are no shoals over $\frac{1}{2}$ mile from shore. Seven and one-half miles north of the red spar buoy a rocky spit with 6 feet of water near its end makes out $1\frac{1}{2}$ miles from shore to the SE. Two and one-fourth miles to the northward and one mile to the eastward of this spit another rocky spit makes out $\frac{3}{4}$ mile from shore with 2 small detached shoals SW. of it.

Bailey Harbor, Middle Ground Shoal, is in the mouth of Bailey Harbor. It is a rocky shoal with 14 feet of water over the southern end and 7 feet on the northern.

Buoy.—The southeastern end of this shoal is marked by a black spar buoy in 18 feet of water.

Bailey Harbor, Eastern Shoal.—From the eastern point of Bailey Harbor a shoal $1\frac{1}{2}$ miles wide makes out to the southward one mile with 13 feet of water on its southwestern and 15 on its southeastern end.

Buoy.—Its southwestern end is marked by a red spar buoy in 18 feet of water.

There is an old white tower (formerly a lighthouse), on the east side of the harbor abreast the point, which serves as a good daymark, and opposite it on the other side of the harbor a shoal makes out $\frac{1}{2}$ mile. Off the center of the town on the west side the shore can be approached to $\frac{1}{4}$ mile. Elsewhere it is best to keep at least $\frac{1}{2}$ mile from shore. Hills rise from the western shore of the harbor.

Bailey Harbor is a well-sheltered anchorage with good holding ground of clay.

Cana Island Light.—A fixed white light, visible $15\frac{1}{2}$ ($17\frac{1}{2}$) miles, is shown from a conical tower connected with a dwelling, both yellow.

Cana Island is 4 miles northward of the entrance to Bailey Harbor and $12\frac{8}{10}$ ($14\frac{2}{5}$) miles southwestward of Porte des Morts entrance to Green Bay.

Point Detour to Manistique, Wisconsin.—The coast from Bailey Harbor to Point Detour is described under the head of **Chicago to Ports in Green Bay**. From Point Detour to Pointe aux Barques, 18 miles, the coast line trends to the NE., is bold and rocky, and much indented with bays. The hills back from the shore are wooded and low.

Shoals.—Shoals extend $\frac{5}{8}$ miles south of Point Detour, but from here to the next point, 4 miles to the northward, there are no shoals more than $\frac{1}{2}$ mile from shore.

Shoals extend $\frac{3}{4}$ mile off this point. It is not safe to approach the coast within $\frac{3}{4}$ mile northward of this.

Portage Bay Shoals.—From the west side of Portage Bay shoals extend for $\frac{3}{4}$ mile from shore, and east of the bay dangerous 5 and 9-foot shoals extend 2 miles to the SE., while $1\frac{1}{2}$ miles to the NE. are some exposed rocks $\frac{3}{4}$ mile from shore. The shoal water at the head of this bay extends $1\frac{1}{2}$ miles from shore.

Parent Bay Shoals.—This bay, to the westward of Pointe aux Barques, is full of rocky, dangerous shoals $1\frac{1}{2}$ miles from shore, and these continue around Pointe aux Barques $\frac{1}{4}$ mile from shore.

From Pointe aux Barques the coast trends more to the northward and is less bold and indented.

Wiggins Point Shoal.—Off Wiggins Point, 4 miles north of Pointe aux Barques, are rocky 5-foot shoals extending $1\frac{1}{2}$ miles from shore and 2 miles north and south.

From this point to the entrance of the Manistique River there are no shoals more than $\frac{1}{4}$ mile from shore. Along the coast for one mile or more it is rocky $\frac{1}{4}$ mile off shore. There is a prominent hill on the right side of the entrance to the river.

Caution.—The channel here is narrow and tortuous, and great care is necessary in entering.

The Coast from Manistique to Pointe aux Chênes.—From Manistique the coast trends nearly east for some distance and is wooded, with small hills back from the shore line.

Shoals.—Two and one-half miles east of Manistique is a 15-foot spot $\frac{1}{8}$ mile from shore, and $3\frac{1}{4}$ miles further east a rocky 8-foot shoal with some exposed rocks $1\frac{1}{2}$ miles from shore.

From this point to Seul Choix Pointe, 10 miles distant, the shore can be safely approached to $\frac{1}{2}$ mile.

Northeast of Seul Choix Pointe the lake makes in to the NW. forming a well-sheltered anchorage from winds from the north to SW.

Seul Choix Pointe Light.—A fixed white light, visible 13 (15) miles, is shown from a pyramidal-shaped tower on the eastern extremity of Seul Choix Pointe.

Shoals.—Between Seul Choix and Hughes Points there are no shoals more than $\frac{1}{4}$ mile from shore until off the latter point, where are 2 small detached spots with 15 and 17 feet of water on them one mile south of the point.

From Hughes Point to Point Patterson, 9 miles, there are no shoals more than $\frac{1}{8}$ mile from shore.

From Point Patterson to Mille Coquins the shore line trends NE. for 10 miles with extensive flats, which increase in width from $\frac{1}{2}$ mile at Point Patterson to $2\frac{1}{2}$ miles 6 miles NE. therefrom, then decrease to less than $\frac{1}{2}$ mile in width 4 miles further on. Five miles SE. of Point Patterson is Lansing shoal. See page 29.

Potter Reef.—Six (7) miles ENE. $\frac{1}{2}$ E. (N. $73^{\circ} 08' E.$) from Point Patterson is a 6-foot reef $\frac{1}{4}$ mile square and unmarked. On the same line of bearing and 3 ($3\frac{1}{2}$) miles further to the NE. are two small, rocky 10-foot spots with a 13-foot spot one mile SE. of them, all unmarked.

From Mille Coquins the coast trends eastward and then SE. to the Straits of Mackinac.

One mile south of Mille Coquins is a small island surrounded by exposed rocks and shoals extending one mile east and west and $\frac{1}{2}$ mile north and south.

One and a half miles SE. from this island is a 7-foot rocky spot.

Between Mille Coquins and Biddle Point shoals extend $\frac{3}{4}$ mile from shore, and east of Biddle Point they reach out from one to 2 miles. An 18-foot detached spot is 2 miles SE. of Biddle Point.

From the latter point to Pointe Epoufette shoals extend one to $1\frac{1}{2}$ miles from shore.

Pelkie Reef is $2\frac{1}{2}$ miles WSW. (S. $67^{\circ} 30'$ W.) from Pointe Epoufette. It is $\frac{3}{8}$ mile square with 7 feet of water on it, and $\frac{1}{4}$ mile to the NE. is a small 17-foot spot.

The indentation in the coast on which is the town of Epoufette, is very shoal. East of this the coast is much bolder and can be safely approached to $\frac{1}{2}$ mile.

Five and one-half miles to the southward and eastward of Pointe Epoufette are two small hills close together and near the coast, and abreast of these hills shoals extend one mile from shore for a distance of $1\frac{1}{2}$ miles.

Manitou Paymen Shoal is 4 miles south from this point; it extends $\frac{3}{4}$ mile NE. and SW. and 800 yards NW. and SE., with a least depth of 6 feet.

Buoy.—A red and black horizontal stripe nun buoy marks the SW. point of the above shoal.

The south bluff of Pointe aux Chênes in line with the north side of Gros Cap crosses Paymen shoal.

For 3 miles to the eastward of these hills shoals extend $\frac{3}{4}$ mile from the shore, and from there to Pointe aux Chênes there is deep water $\frac{1}{4}$ mile from shore.

See Chapter X for further description of this coast.

CHAPTER VI.

CHICAGO TO PORTS IN GREEN BAY, WISCONSIN.

When $1\frac{1}{2}$ ($2\frac{1}{4}$) miles east from Chicago Pierhead light, steer N. $\frac{3}{4}$ E. (N. $8^{\circ} 26'$ E.) $202\frac{1}{2}$ (233) miles to a point 2 ($2\frac{1}{2}$) miles SSE. (S. $22^{\circ} 30'$ E.) from Pilot Island light, when steer NW. $4\frac{1}{2}$ (5) miles until the NW. end of Plum Island bears abeam, when take departure for the different ports in Green Bay. (U. S. Engineers' Chart, No. 33.)

From the north entrance of Sturgeon Bay Canal the west shore of Lake Michigan is indented with numerous bays, and the offlying rocks and shoals increase in number as the entrance to Green Bay is approached. A chain of islands extends across the mouth of Green Bay.

Mud Bay.—To the NE. of Bailey Harbor is another small harbor, Mud Bay. It is very contracted, with a shoal near the center; and, having neither buoys nor lights, is not recommended except for small vessels whose masters are familiar with these waters. From here to North Bay keep $\frac{1}{2}$ mile off shore.

Cana Island is 4 miles NE. of Bailey Harbor entrance. Shoal water extends $\frac{1}{2}$ mile from the island.

Cana Island Light.—A fixed white light, visible $15\frac{2}{10}$ ($17\frac{1}{2}$) miles, is shown from a conical tower.

To the NW. of Cana light is a hill $1\frac{1}{2}$ miles inland.

North Bay.—Three miles north of Cana Island is North Bay, a small anchorage, nearly circular, $\frac{3}{4}$ mile in diameter, and sheltered from all except east winds.

Shoals.—A sand spit extends $\frac{5}{8}$ mile eastward from the south side of the entrance.

Buoy.—The extremity of this spit is marked by a black spar buoy, No. 1. There is a small detached shoal west of this buoy.

A sand spit extends from the north side of the entrance $\frac{1}{2}$ mile.

Buoy.—The point of this spit is marked by a red spar buoy, No. 2.

Shoal water at the head of the bay extends $1\frac{1}{4}$ miles from shore.

Directions for Entering.—Keep midway between the buoys, which are $\frac{3}{8}$ mile apart, and round-to behind either point, according to the wind.

From North Bay to the end of the peninsula there are hills a short distance back from the coast. Wide flats with numerous offlying shoals line the shore.

Rawley Bay.—This bay, to the northward of North Bay, affords good anchorage, but numerous shoals make the entrance to it difficult.

Four Foot Shoal lies in the entrance of Rawley Bay, beginning 3 miles NE. from the entrance of North Bay. It extends $2\frac{1}{4}$ miles north, with 3 feet of water on the southern and 4 feet on the northern end, with 12 feet in the center.

Buoy.—A red spar buoy marks the SE. end of the shoal.

From the east point of Rawley Bay a shoal extends $1\frac{1}{4}$ miles south, with a detached 13-foot spot $1\frac{1}{2}$ miles to the eastward of the extremity of the shoal. Between this detached spot and the shore to the NW. lies a group of very small islands, called Spider Islands, $\frac{1}{2}$ mile off shore, with flats $\frac{3}{4}$ to $1\frac{1}{4}$ miles wide extending north along the shore. One mile north of Spider Islands are some exposed rocks $\frac{3}{8}$ mile from shore.

From these islands a chain of detached shoals extends to the NE. $2\frac{3}{4}$ miles, with a buoy on the outer shoal. The next to the outer has but 8 feet of water over it.

Outer Shoal.—This shoal, 2 miles from the shore, has 14 feet of water on its northern end.

Buoy.—The southern end of this shoal is marked by a red nun buoy.

Caution.—Do not go between this buoy and the shore.

NW. of this buoy shoals extend $1\frac{1}{2}$ miles from the mainland, and include Gravel Island, one mile from shore and 2 miles NW. of the buoy. One mile north from the buoy is a 17-foot spot.

Pilot Island (Porte des Morts).—This small island, with a light and fog signal, is 4 miles N. by E. from the outer shoal buoy (red nun), with shoals extending $\frac{1}{4}$ mile east, west, and south.

Pilot Island Light (Porte des Morts) is a fixed white light, varied by a white flash every 15 seconds, visible $11\frac{1}{2}$ (13) miles. It is shown from a square tower on a yellow dwelling on Pilot Island.

Fog Signal.—A steam whistle sounds blasts of 5 seconds duration with silent intervals of 30 seconds.

Nine Foot Shoal.—Three-fourths mile off shore and 2 miles WSW. (S. $67^{\circ} 30'$ W.) from Pilot Island lies a 9-foot shoal $\frac{1}{3}$ by $\frac{1}{4}$ mile in extent.

Buoy.—A black nun buoy marks the SE. end of the 9-foot shoal.

Five-eighths mile N. $\frac{3}{4}$ E. (N. $8^{\circ} 26'$ E.) from this buoy is a 17-foot spot.

Plum Island.—A small island $\frac{3}{4}$ mile square forms the NW. end of Porte des Morts Channel and can be safely approached to $\frac{1}{4}$ mile except on the northern side, where shoals extend for $\frac{1}{2}$ mile.

Buoy.—A black spar buoy marks the NE. end of the shoal extending north from Plum Island. It can be passed close to to the northward, otherwise it should be given a berth of at least $\frac{1}{2}$ mile.

Daymark.—On the SW. end of Plum Island is the ruin of an old lighthouse.

The coast of the mainland to the SW. is steep-to and can be safely approached.

ISLANDS AT THE MOUTH OF GREEN BAY.

Detroit Island.—This long, narrow island, lying to the southward of Washington Island, is practically part of it, as very shoal water connects the two. A harbor for small vessels can be found by rounding the north end of Detroit Island.

Shoals.—From the southern end of Detroit Island shoals extend $\frac{3}{4}$ mile to the SE., with 6 feet of water and rocks awash $\frac{1}{4}$ mile from shore.

On the SW. side of Detroit Island the flats and detached shoals extend $\frac{7}{8}$ mile from shore, the northwestern shoal with 10 feet of water over it being marked by a buoy. Near the SW. end of the island are two islets $\frac{1}{8}$ mile off shore.

Buoy.—The SW. point of the northwestern shoal is marked by a red spar buoy.

Detroit Island Passage.—This passage to the northward of Pilot and Plum islands can be used with great care, avoiding the shoals off Detroit and Plum islands. It is frequently used as an anchorage during easterly gales.

In running this passage a mid-channel course from between Pilot Island and the SW. point of Detroit Island to the southward of the buoy, close-to, will carry through.

Washington Island, $3\frac{1}{2}$ miles from the mainland and extending 6 miles north and south by 5 miles east and west, is connected by shoals with Detroit Island on the south. Hog Island, a very small island, lies to the eastward and Rock Island to the northeast.

Shoals.—Off the SE. end of Washington Island the shoal water does not reach more than $\frac{1}{4}$ mile from shore until near Hog Island, with the single exception of a small detached shoal $\frac{3}{8}$ mile off shore.

Near Hog Island shoal water extends $1\frac{1}{8}$ miles from the shore, extending to the northward and eastward, and from there to the SE. point of Rock Island 5 feet of water is found in several places $\frac{1}{2}$ mile from shore.

Offlying Reefs.—Three and one-half miles E. by N. (N. $78^{\circ} 45'$ E.) from Hog Island is a rocky 3-foot shoal extending $1\frac{1}{4}$ miles north and south and $\frac{1}{2}$ mile east and west.

Two miles NNE. from this reef and $2\frac{1}{4}$ miles SE. by E. $\frac{3}{4}$ E. (S. $64^{\circ} 41'$ E.) from the SE. point of Rock Island is another reef just awash, (Fisherman's reef).

The coast of Rock and Washington islands to the SW. is steep-to and can be safely approached to $\frac{1}{4}$ mile excepting Jackson Harbor.

Washington Harbor on the NW. side of Washington Island is a good harbor except in northerly gales.

On the SW. coast of Washington Island $1\frac{3}{8}$ miles from the SW. end is an indentation with shoals and offlying islands.

Shoal.—A 9-foot shoal with a 15-foot spot $\frac{1}{2}$ mile NNE. of it lies $2\frac{3}{8}$ (3) miles NE. by E. $\frac{1}{2}$ E. (N. $61^{\circ} 53'$ E.) from Rock Island light. It is of small extent with deep water close-to.

Buoy.—A red can buoy marks the SW. end of the shoal.

St. Martin Island.—The south part of this island is $4\frac{1}{8}$ ($4\frac{1}{2}$) miles NE. from Pottawatomie light. It extends 2 miles north and south and $1\frac{1}{2}$ miles east and west.

Shoals extend off the southern end one mile with 4 to 8 feet of water over them. The remaining sides of the island are steep-to and can be safely approached to $\frac{1}{4}$ mile.

Gull Island.—East 2 ($2\frac{1}{4}$) miles from the north end of St. Martin Island are Gull Island and Little Gull Island connected by a shoal with a least depth of 3 feet.

Gravelly Island is $\frac{3}{4}$ mile N. by W. (N. $11^{\circ} 15'$ W.) from Gull Island. It is surrounded by shoal water.

A passage should not be attempted between Gravelly Island and Gull Island.

Gravelly Island Shoal is $1\frac{1}{8}$ miles north of Gravelly Island. It is a rock with 16 feet of water on it.

Buoy.—A black can buoy marks the rock.

Between the buoy and the island is a 13-foot spot.

Poverty Island lies 3 miles east of Gravelly Island and one mile SW. of Summer Island. It is $\frac{3}{4}$ mile long north and south by $\frac{1}{2}$ mile wide with a hill on the western side.

Shoal.—Shoal water extends $\frac{1}{4}$ mile SW. and $\frac{1}{8}$ mile SE., east and NE. The NW. and west sides are steep-to.

Poverty Island Light.—A flashing red light every 15 seconds, visible $14\frac{1}{2}$ ($16\frac{1}{2}$) miles, is shown from a conical tower connected with a white dwelling on the south end of Poverty Island.

Fog Signal.—A steam whistle sounds a blast of 5 seconds duration followed by a silent interval of 45 seconds, then a blast of 3 seconds duration followed by a silent interval of 10 seconds.

Poverty Island Shoal lies NW. $\frac{1}{4}$ W. (N. $47^{\circ} 49'$ W.) $2\frac{1}{8}$ ($2\frac{1}{2}$) miles from Poverty Island light with 14 feet of water over it.

Buoy.—It is marked by a red nun buoy.

This buoy, $\frac{1}{2}$ mile south of the shoal, marks a narrow ledge of rocks with 23 feet of water over them extending about 500 yards S. by E. from the buoy. There may be less water in spots over this ledge, and caution is necessary with deeply laden vessels.

Poverty Island Passage.—If entering Green Bay by this passage keep at least one mile to the southward of Poverty Island light and between the buoys, not approaching Poverty Island Shoal buoy nearer than $\frac{1}{4}$ mile.

Bring Gravelly Island buoy to bear south before keeping to the northward.

Caution.—When standing to the northward through Poverty Island passage, do not bring the western edge of Burnt Bluff to bear west of north. This will clear the 13-foot spot off Rocky Island.

Summer Island is between Poverty Island and Point Detour. There is a hill near the center of the island sloping gradually to the coast. The island is $2\frac{3}{8}$ (3) miles long north and south and $1\frac{1}{4}$ ($1\frac{1}{2}$) miles broad.

Shoals.—A rocky 13-foot shoal extends $\frac{5}{8}$ mile south from the island. The eastern shore can be approached to $\frac{1}{4}$ mile. Shoals extend along the west coast joining those around Little Summer and Rocky islands. There is a depth of 10 feet of water on the outer point of the shoal between Summer and Little Summer islands.

Little Summer Island lies $1\frac{1}{2}$ miles NW. from the northern point of Summer Island. It extends $1\frac{1}{2}$ miles north and south and $\frac{3}{4}$ mile east and west.

Rocky Island.—This small island, $\frac{1}{2}$ mile long east and west lies $\frac{1}{2}$ mile west of Little Summer Island. Shoals extend $\frac{3}{8}$ mile west and a shoal, just awash, $\frac{1}{2}$ mile to the north.

One and one-half miles south of Rocky Island and $2\frac{3}{4}$ miles west of the northern point of Summer Island is a detached 13-foot rocky spot.

Between these islands and the mainland are flats and shoals, but north of Summer Island under Point Detour is good anchorage.

Plum Island to Big Bay de Noquette.—Steer N. $\frac{3}{8}$ E. (N. $7^{\circ} 02' E.$) until Boyer bluff bears SE. by E. $\frac{3}{4}$ E. (S. $64^{\circ} 41' E.$), when head NNE. $\frac{7}{8}$ E. (N. $32^{\circ} 21' E.$). This course will carry $\frac{1}{4}$ mile off Burnt Bluff and nearly the same distance off Garden Bluff and $1\frac{1}{2}$ miles off Valentines Point.

After passing Boyer Bluff, Pottawatomie (Rock Island) light may be sighted to the eastward, distant when abeam $4\frac{1}{8}$ (5) miles.

Pottawatomie Light (Rock Island).—A fixed white light, visible $17\frac{1}{10}$ ($19\frac{1}{4}$), miles, is shown from a square tower on a gray dwelling on the north point of Rock Island, Wisconsin.

Drisco Shoal, $4\frac{1}{8}$ (5) miles west of the course, is a small shoal with 11 feet over it. It comes abeam to port just before St. Martin Island bears abeam to starboard. The soundings in its vicinity can not be depended upon to give warning in thick weather.

Buoy.—A red and black horizontal stripe can buoy marks the southeastern point of Drisco shoal. It is moored in 21 feet of water.

Standing north into Big Bay de Noquette, the eastern shore is bold with no offlying shoals. Between Middle Bluff and Burnt Bluff there is a good anchorage against easterly winds.

Beyond Middle Bluff, Snake Island lies $\frac{3}{8}$ mile off the shore with shoals extending from it to the mainland.

Shoal.—One mile NNE. (N. 22° 30' E.) of Snake Island is a stony 12-foot spot.

Garden Bay.—This bay affords shelter to small vessels.

Ansels Point can be approached to $\frac{1}{4}$ mile, and here is the best anchorage with clay bottom.

Kates Bay, the indentation north of Ansels Point, is shoal.

At the head of Big Bay de Noquette shoal water extends $2\frac{1}{2}$ ($2\frac{3}{4}$) miles from the north shore, one mile from the east shore, and 2 miles from the west shore, at Stony Point.

The west shore of Big Bay de Noquette is low and wooded, with flats extending far out along the coast.

Shoal.—From Stony Point and Indian Point a shoal makes to the southward, $5\frac{1}{2}$ ($6\frac{1}{2}$) miles, with 16 feet at the south end. Only small vessels should cross this shoal.

Round Island, a small triangular island $\frac{1}{4}$ mile on the side, lies NW. by N. $4\frac{1}{2}$ miles from Burnt Bluff, and to the northward and westward are numerous shoals extending to the head of Ogantz Bay.

Shoals.—There is a 3-foot shoal $1\frac{1}{2}$ miles to the northward and one mile to the NW. of Round Island.

St. Vital Island is a small island 4 miles north of Round Island. There is shoal water between it and the shore.

Ogantz Bay.—Keep one mile to the eastward of Round and St. Vital islands in entering this bay on a course N. $\frac{3}{8}$ W. (N. 4° 13' W.) until past St. Vital Island when head NNW. $\frac{3}{8}$ W. (N. 26° 43' W.) for Pickerel River.

Plum Island to Escanaba and Little Bay de Noquette.—Steer N. $\frac{1}{2}$ W. (N. 5° 37' W.) passing the Eleven Foot Shoal lightvessel on the starboard beam, distant one mile. This course will carry $\frac{1}{8}$ mile outside the buoy off Escanaba shoal, Sand Point.

Intending to continue up the bay, from the black spar buoy head N. $\frac{1}{4}$ E. (N. 2° 49' E.) until Squaw Point bears NE., then head NE. $\frac{3}{4}$ N. (N. 36° 34' E.) until $\frac{1}{4}$ mile off and abeam of Saunders Point, then N. by E. $\frac{3}{4}$ E. (N. 19° 41' E.) to the anchorage $\frac{3}{4}$ mile from shore.

The coast of this bay is low and wooded, with many offlying rocks and shoals. Shoal water extends from the east shore below Squaw Point $2\frac{1}{4}$ miles. Do not pass to the eastward of a line joining this point and Sand Point light.

Eleven Foot Shoal Lightvessel.—A schooner-rigged vessel, No. 60, lies $3\frac{1}{4}$ ($4\frac{1}{2}$) miles S. by W. $\frac{3}{4}$ W. (S. $18^{\circ} 17'$ W.) from Point Peninsula light in 60 feet of water. It shows a fixed white light visible $11\frac{1}{2}$ ($13\frac{1}{2}$) miles. A black circular daymark is shown at the foremast head.

Fog Signal.—A steam whistle sounds blasts of 5 seconds duration followed by silent intervals of 10 seconds. If whistle be disabled a bell will be rung by hand.

It marks the shoal off Peninsula Point and the turning point for vessels bound from one bay to the other.

Point Peninsula Light.—A flashing white light every 30 seconds, visible $11\frac{1}{2}$ ($13\frac{1}{2}$) miles, is shown from a square tower attached to a dwelling on the extremity of the point between Little and Big Bays de Noquette. The buildings are yellow with red roofs.

Peninsula Point Shoal.—A dangerous rocky shoal extends south $1\frac{1}{2}$ miles from Peninsula Point with 2 feet of water one mile from shore.

Buoy.—A red spar buoy marks the south end of the shoal.

Eleven Foot Shoal is a detached spot one mile SSW. $\frac{1}{4}$ W. (S. $30^{\circ} 56'$ W.) from Point Peninsula buoy.

Buoy.—A red nun buoy marks the south side of this shoal and is on a range between Eleven Foot Shoal lightvessel and Peninsula Point.

Fifteen Foot Shoal.—There is a small spot with 15 feet of water on it E. $\frac{1}{2}$ N. $\frac{1}{2}$ mile from the Eleven Foot Shoal buoy.

Corona Shoal.—S. $\frac{1}{2}$ E. (S. $5^{\circ} 37'$ E.) 3 ($3\frac{3}{4}$) miles from Point Peninsula is a $12\frac{1}{2}$ -foot spot with a greatest extent of 275 yards NNE. and SSW. The least water is 100 yards NE. of the buoy.

Buoy.—A red and black horizontal stripe spar buoy marks the southern point of Corona shoal in 18 feet of water.

From Point Peninsula the shore extends north about $1\frac{1}{2}$ miles and then curves to the westward for one mile, this indentation being filled with rocky shoals extending $\frac{3}{4}$ mile from shore.

From this point the coast line runs north with no shoals more than $\frac{1}{2}$ mile from shore till Escanaba is passed.

Little Bay De Noquette Shoal.—About one mile north of Escanaba, flats extend 2 to $2\frac{1}{2}$ miles from the east shore of the bay, leaving a regular channel about $1\frac{1}{3}$ miles wide.

Buoy.—A red can boy marks the southwestern point of the shoal.

Sand Point Shoal (off Escanaba).—A shoal extends $\frac{3}{8}$ mile northeastwardly from Escanaba light.

Buoy.—A black spar buoy marks the end of the shoal. Along the west coast shoal water extends $\frac{1}{2}$ to $\frac{5}{8}$ mile until near Saunders Point when it recedes to $\frac{1}{4}$ mile from shore. North of this point shoal water extends $\frac{3}{4}$ mile from shore. North of Squaw Point the shoals extend $\frac{1}{4}$ to $\frac{1}{3}$ mile from shore.

Buoys.—A black can buoy marks the eastern point of the shoal, making out from Saunders Point, and is 260 yards NE. by E. $\frac{1}{2}$ E. (N. $61^{\circ} 52'$ E.) from the end of the wharf at Saunders Point.

One-fourth mile to the northward and westward from the above buoy is a black spar buoy marking the northern end of the shoal off Saunders Point and 420 yards N. $\frac{1}{4}$ W. (N. $8^{\circ} 26'$ W.) from the end of the wharf.

Southward from Escanaba wide flats extend from one to 3 miles from shore for $10\frac{3}{4}$ (12) miles along the coast.

Vessels going south should not pass to the westward of a line drawn south from Sand Point buoy until abeam of Point Peninsula light.

From this point for $4\frac{1}{2}$ (5) miles rocky shoals extend $1\frac{1}{2}$ miles from shore.

For the rest of the way to Cedar River there are no shoals more than $\frac{1}{4}$ mile from shore until $4\frac{1}{2}$ (5) miles north of this harbor, where a rocky spit with exposed rocks on it makes out $\frac{1}{2}$ mile.

Plum Island to Cedar River, Michigan.

Head WNW. $\frac{1}{2}$ W. (N. $73^{\circ} 08'$ W.) passing south of Whaleback shoal until Cedar River light bears NNW. $\frac{1}{2}$ W. (N. $28^{\circ} 08'$ W.) $2\frac{1}{2}$ ($2\frac{1}{2}$) miles, when stand in on the range. The coast here is low and wooded.

Whaleback Shoal lies in the center of Green Bay nearly in line with Plum Island and Cedar River Harbor. It is $1\frac{1}{2}$ miles long NW. and SE. and $\frac{3}{8}$ mile wide. The shoalest spot is half way between the buoys and nearly awash.

The soundings in the vicinity of the shoal are irregular; bottom, stone, sand, and gravel.

Buoys.—Whaleback shoal, east end, a red spar buoy in 18 feet of water marks the southeastern point of Whaleback shoal.

Whaleback shoal, west end, a black spar buoy in 18 feet of water marks the northwestern point.

Caution.—Great care is necessary in entering Cedar River Harbor as there are unmarked shoals on each side of the course.

Cedar River Light.—A fixed white light, visible $13\frac{1}{10}$ ($15\frac{1}{4}$) miles, is shown from a square white tower near the outer end of the east pier at the mouth of Cedar River.

Shoals.—There is a 17-foot spot SE. by E. $\frac{1}{2}$ E. (S. $61^{\circ} 52'$ E.) $\frac{3}{4}$ mile from Cedar River light with shoal water extending to the shore.

Cedar River Entrance Shoals are $\frac{7}{8}$ mile from shore with 12 feet of water on the outer one.

Buoy.—A rock with 13 feet of water on it 555 yards S. $\frac{1}{4}$ W. (S. $2^{\circ} 49'$ W.) from Cedar River light is marked by a black spar buoy.

Plum Island to Menominee, Michigan.

Head west until Death Door Bluff bears south, then WSW. $\frac{1}{4}$ W. (S. $70^{\circ} 19'$ W.) until Chambers Island light bears south $1\frac{1}{4}$ ($1\frac{1}{2}$) miles, then SW. by W. (S. $56^{\circ} 15'$ W.) to the anchorage off Menominee.

Between Cedar River and Menominee the coast trends SSW. $\frac{1}{2}$ W., and is fairly regular, low and wooded.

Shoal water extends $\frac{3}{4}$ mile from shore. Four and three-fourths ($5\frac{1}{2}$) miles below Cedar River there is an 11-foot spot $1\frac{1}{4}$ miles from shore, and 4 miles further to the SW. there is a 15-foot shoal one mile from shore.

From 4 to 6 miles north of Menominee light and west of the southern part of Chambers Island are several detached spots from one to $1\frac{1}{4}$ miles off shore, the northern one having 14 feet and the southern 16 feet of water.

Two and one-half miles NW. of Menominee light and $\frac{1}{4}$ mile from shore is Bum Island, a small island with an 11-foot shoal extending $\frac{1}{2}$ mile to the SE. and $\frac{3}{4}$ mile from shore.

From here to Menominee light shoal water makes out $\frac{1}{4}$ mile South and SE. of the light, flats with but 4 feet over them extend 2 miles from shore.

Chambers Island lies near the center of Green Bay. The east and west sides of the island extend nearly north and south, the east side being $3\frac{1}{4}$ and the west side 2 miles long.

A prominent point forms the NE. end. There is a lake back of it. There are two points at the NW. end, the lighthouse being on the most northern one.

A hill rises back of the lighthouse with another to the SE.

The south side is almost a strait line, trending $2\frac{1}{4}$ miles SE. by E. $\frac{1}{4}$ E. forming a long sharp point at the intersection with the east side.

The island is wooded and much of its coast line consists of low bluffs.

Chambers Island Light.—A fixed white light varied by a white flash every minute, visible $13\frac{2}{10}$ (16) miles, is shown from an octagonal tower on the NW. corner of a dwelling, both being yellow, on the northern point of the NW. end of the island.

Shoals.—A reef extends $\frac{3}{4}$ mile from the north point, and the bay on the north side is full of shoals extending $\frac{3}{4}$ mile from shore.

Standing along the west side of the island shoal water extends about $\frac{1}{2}$ mile from shore. Off the SW. point a narrow spit with 16 to 17 feet of water on it makes out $1\frac{1}{4}$ miles west.

There are no shoals on the south shore more than $\frac{1}{4}$ mile from shore.

A spit 2 miles long with 8 feet least water $1\frac{1}{2}$ miles from shore makes out from the SE. point in the prolongation of the south shore; shoal water extends $\frac{3}{4}$ mile from the east shore, and about midway is a detached 14-foot spot $1\frac{1}{4}$ miles from shore.

Caution.—Do not pass between Chambers Island and the Strawberries.

From Plum Island to Green Bay, Wisconsin.—Follow directions to Menominee until Chambers Island light bears south. From here head SW. by W. (S. 56° $15'$ W.) until the light bears east, then S. by W. (S.

11° 15' W.) until Green Island light bears abeam, when change course to SW. $\frac{1}{2}$ S. (S. 39° 23' W.) to abeam of Long Tail Point light. Keep a bright lookout for the red can buoy off Peshtigo Point reef, keeping it to starboard.

This carries to a point about one mile SE. of the lighthouse on Long Tail Point and about $\frac{1}{2}$ mile east of the red can buoy on the shoal off that point. From here follow the directions for entering the harbor.

Green Island is a small island 5 miles SE. by E. from Menominee light. It is $\frac{7}{8}$ mile long by $\frac{1}{4}$ mile wide. The island is wooded and surrounded by reefs extending $\frac{3}{4}$ mile to the westward and $\frac{1}{2}$ mile to the SE.

Below Menominee the west shore of Green Bay is generally low, consisting of flats and offlying shoals of great extent while the east shore is bolder and often steep-to with numerous small offlying islands, reefs, rocks, and shoals.

Green Island Light.—A fixed white light, visible $12\frac{8}{10}$ ($14\frac{1}{2}$) miles, is shown from a square tower on a yellow dwelling near the SE. point of Green Island.

Peshtigo Shoal, $1\frac{1}{2}$ to $\frac{3}{4}$ mile wide, reaches 3 miles SE. from Peshtigo Point with 6 feet of water near the buoy.

Buoy.—A red can buoy in 21 feet of water marks the extreme SE. point of the shoal. Vessels should not attempt to pass between the buoy and the point, and if bound to Peshtigo River from the northward, should pass the buoy $\frac{3}{4}$ mile before heading for the mouth of the river. The coast here turns abruptly to the west for 9 miles then trends south again.

Pensaukee Shoal extends $3\frac{1}{4}$ miles from shore with 7 feet of water at the SE. end.

Between these two shoals flats extend over 3 miles from shore. There is a dangerous detached shoal 4 to $6\frac{1}{2}$ miles NE. of Pensaukee shoal and $3\frac{1}{2}$ miles from shore.

From Pensaukee Point to the head of Green Bay the western shore is lined with rocky flats making out for 2 to 3 miles. Nine miles from the head of the bay, Little Tail Point, a narrow detached point, reaches out $1\frac{1}{4}$ miles from shore and 4 miles north of Fox River entrance, Long Tail Point reaches $2\frac{1}{4}$ miles to the SE. with a lighthouse on the outer end.

Tail Point Light.—A fixed white light, visible 13 (15) miles, is shown from a square tower on a white dwelling. It is on the south end of Long Tail Point.

Fog Signal.—A bell struck one blow, by machinery, every 10 seconds.

Long Tail Shoal.—Shoals extend one mile to the south and east from this point as well as northerly along the coast.

Buoy.—A red can buoy in 16 feet of water marks the point of the shoal south of Long Tail Point.

Between Long Tail Point and Red Bank the water is generally shoal.

Red Bank is a prominent bluff 3 miles from Sable Point.

From Red Bank Bluff to Little Sturgeon Bay the shore can be approached to $\frac{3}{4}$ mile.

Little Sturgeon Bay is very shallow; NE. of it are many shoals.

Snake Island, a small island $1\frac{1}{2}$ miles east of Little Sturgeon Bay, is $1\frac{1}{4}$ miles from shore.

From Snake Island to Sherwood Point the shore should not be approached within 2 miles until the point bears E. by S.

Standing up the coast from Green Bay for Sturgeon Bay, the course is NE. (N. 45° E.) until Sherwood Point light bears E. by S., when head in, keeping the light open on the starboard bow.

Sturgeon Bay is the west entrance to the cut through the peninsula between Green Bay and Lake Michigan, a canal connecting it with the lake at the SE. end.

Sherwood Point Light.—A fixed white light varied by a red flash every minute and visible $13\frac{1}{2}$ ($15\frac{1}{2}$) miles, is shown from a square tower on the north end of a dwelling, both red. The tower is on Sherwood Point and marks the south side of the entrance to the bay.

Fog Signal.—A bell is struck one blow, by machinery, every 12 seconds.

The coast north of Sturgeon Bay is steep to until $5\frac{3}{4}$ ($6\frac{1}{2}$) miles north of Sherwood Point light, when detached spots occur $1\frac{1}{8}$ miles from shore for a distance of 4 miles. The least depth on one of these is 9 feet.

Egg Harbor, $11\frac{7}{10}$ ($13\frac{1}{2}$) miles beyond Sherwood Point light, is $\frac{1}{2}$ mile wide by $\frac{3}{4}$ mile long north and south. It is a good harbor except in case of north or NW. gales.

Shoals.—Shoals extend off the west point $\frac{3}{8}$ mile to the northward and eastward. The coast to Eagle Harbor (excepting Fish Creek Bay) can be approached to $\frac{1}{4}$ mile.

Hat Island lies NNW. $3\frac{1}{2}$ miles from the entrance of Egg Harbor. A shoal extends $\frac{1}{2}$ mile east and SE. from it.

Detached Shoal.—A detached shoal $\frac{1}{4}$ mile square lies one mile SSW. of Hat Island.

Eagle Bluff Light.—A fixed white light visible $14\frac{3}{10}$ ($16\frac{1}{2}$) miles, is shown from a square tower attached to the NW. corner of a dwelling on the extreme westerly point of Eagle Bluff. Both buildings are yellow with red roofs.

Here the coast is dangerous, the SE. shoals on Chambers Island reaching to within $2\frac{1}{2}$ miles from the coast, and west from Eagle Bluff are the Strawberry Islands with their shoals.

The Strawberry Island Group consists of 3 or 4 islands, the southern one being the largest. They are connected by shoals with several small detached shoals to the south. A channel a mile wide separates them from

the mainland. With the shoals the group is 3 miles north and south and $1\frac{1}{4}$ miles wide.

Buoys.—Strawberry Channel, SE., a red spar buoy in 13 feet of water marks the SE. end of this group. Pass close to the buoy.

Strawberry Channel, NE., a red spar buoy in 24 feet of water marks the NE. end.

Horseshoe Island lies in the mouth of Eagle Harbor. It is $\frac{1}{2}$ mile NE. of Eagle Bluff.

The shoals around the island do not extend more than $\frac{1}{8}$ mile from it.

Eagle Harbor is eastward of the bluff. It affords good anchorage except in north or NW. gales.

Shoals.—Excepting the head of the bay off the town of Ephraim where shoals extend $\frac{1}{8}$ mile from shore, the shore can be approached to $\frac{1}{4}$ mile.

Sister Shoals.—Four miles NE. of Eagle Bluff light are 3 small shoals with 5 feet of water over them.

Sister Islands.—One and one-half miles further NE. are these small islands, with shoals, extending $\frac{1}{8}$ mile NW. and SE., and $\frac{1}{2}$ mile wide. They are $\frac{1}{4}$ mile from the shore. A spit extends $\frac{3}{8}$ mile from the main shore towards the Sister Islands.

South of the islands $1\frac{1}{4}$ miles is a 17-foot spot.

Horseshoe Reefs lie north $3\frac{1}{8}$ miles from Horseshoe Island and the same distance west from Sister Islands. They consist of two shoal patches with a least depth of 5 feet and one 17-foot patch.

Buoy.—A red can buoy in 36 feet of water marks these. It is $\frac{1}{2}$ mile eastward of the northern end of the reefs.

In passing along the coast keep close to this buoy and to the eastward of it.

Five miles NE. from this buoy is Sister Bluff, 100 feet high, with a small bay east of it.

Ellison Bay affords good anchorage except in north or NW. gales.

From here on around Death Door Bluff to Plum Island the shore can be safely approached to $\frac{1}{4}$ mile.

There is a passage close to the east shore, inside of Hat Island, the Strawberries and Horeshoe reefs, but it is not recommended to any one unfamiliar with these waters.

CHAPTER VII.

PORTS ON THE SOUTH AND EAST SHORES.

Calumet (South Chicago), Illinois.—This harbor, at the mouth of the Calumet River, is $10\frac{3}{4}$ (12) miles from Chicago Harbor. The harbor is formed by two parallel piers, 300 feet apart, extending into the lake from the river's mouth in a NW. direction, the piers being sand tight and the channel being dredged between them. The north pier is (1893) 3,640 feet and the south pier 2,020 feet long; the latter is to be extended 800 feet. It is difficult to keep the channel clear of sand which here has the nature of quicksand.

The channel, as far as the Illinois Steel Company's slip, has (June, 1894) a depth of 17 feet with a width of 250 feet.

A basin has been constructed by the Illinois Steel Company for its own use; it is 3,000 feet north of Calumet Harbor and consists of a slip 1,500 feet long and 200 feet wide, the mouth being contracted to 100 feet. It had (April, 1894) a depth of 19 feet.

Three red buoys mark the north side and 2 black buoys the south side of the channel to this slip, the inner buoys marking the turn.

Calumet Pierhead Light.—A fixed red light, visible $11\frac{1}{10}$ ($12\frac{3}{4}$) miles, is shown from a square, gray tower on the outer end of the north pier.

Fog Signal.—A tug usually lies near the end of the pier, and if incoming steamers blow four (4) whistles, the tug answers night and day.

Life-Saving Station.—There is a Life-Saving Station on the north side of the entrance.

Buoys.—Calumet entrance (south) a black spar buoy in 18 feet of water marks the south bank of the channel leading into Calumet River.

Calumet entrance (north) a red spar buoy in $18\frac{1}{2}$ feet of water marks the north bank of the channel leading into Calumet River.

These buoys are about 200 feet apart and from 200 to 300 feet outside the end of the north pier.

Dry Dock.—The Chicago Ship Building Company has completed a dry dock on the Calumet River. It is 425 feet long, 100 feet wide at the top, 80 feet wide at the bottom, with a gate 70 feet wide, and 18 feet of water over the sill. There is also a 100 ton sheers here, as also all conveniences for repairing vessels.

Directions for Entering the Harbor.—When one mile off the entrance with the light bearing SW. by W. $\frac{1}{4}$ W. (S. $59^{\circ} 04'$ W.) head for the piers, end on. When the light bears SW. $\frac{1}{2}$ W. (S. $50^{\circ} 38'$ W.) it will be on a

range with the red light on the 92d street bridge. The fair weather channel lies between the entrance buoys. Light draft vessels can, after passing Clarke Point bring the Pierhead light to bear SSW. and head for it, rounding the north pier 100 feet distant and keeping 50 feet from the north pier after entering the channel. In heavy weather and entering at night, light draft vessels should approach the entrance with the pier bearing south, clear the pier about 150 feet and head into the harbor. In this way the current sweeping past the end of the north pier toward the south pier is avoided.

It is safe to enter here in ordinary blows, but not in severe gales; the NW. winds being the most dangerous. There is good anchorage outside with good holding ground of clay beneath the sand.

Caution.—There is a shoal south of the entrance on a line with the south pier and outside of the north pier. Keep the north pier closer aboard.

An electric light on the end of the Illinois Steel Company's ore dock is used by persons familiar with the harbor as a guide at night. As there is no fog signal it is not safe to attempt the entrance in thick weather.

Currents.—A current sweeps down the coast from the northward, and strong currents across the ends of the piers have been noticed at times, necessitating care in entering.

Entering the Illinois Steel Company's New Harbor.—Head for Calumet Pierhead light SSW. (S. 22° 30' W.) until the stacks of the furnaces are opened up, then head in the channel between the buoys until the stacks are all in line, when head in on this range W. $\frac{1}{2}$ S. (S. 84° 23' W.) until abreast of the third red buoy, when haul up for the piers.

Caution.—There is a bar with 14 feet of water on it extending to the dredged channel off the SE. end of the north pier of this harbor.

Michigan City, Indiana, is at the SE. end of Lake Michigan. Trail Creek, a small stream, winds through the city emptying into the lake.

The inner harbor is formed by two piers 100 feet apart at the shore line (the mouth of the creek) and 250 feet apart at the outer end of the eastern pier 800 feet from shore. The western pier extends to the line of the old breakwater and 500 feet further out than the eastern pier. The depth is from 12 to 18 feet. The east pier had an original length of 1,500 feet, but the outer 700 feet have been destroyed by the waves. A lookout for the wrecked portion should be kept when approaching the harbor.

The Outer harbor is formed by a 1,200-foot pier projecting from a point on the shore 1,400 feet east of the entrance and a breakwater 1,400 feet long extending west from the end of the east pier. These, with the prolonged pier on the west side, inclose an area of 40 acres. An opening 215 feet wide was left at the NW. angle, consequently this harbor is of no use to other vessels than row boats.

An outer breakwater has been commenced.

The width of the entrance between the Outer breakwater and the northern extension of the Old breakwater is 400 feet, and the width of the entrance between the west pier and the Old breakwater is 215 feet.

The depth at the entrance to the harbor was (January, 1894) 18 feet. The Outer Harbor basin is shallow.

Lights.—Michigan City light, a fixed white light, visible $12\frac{5}{10}$ ($14\frac{1}{2}$) miles, is shown from a square tower on a yellow dwelling, both with red roofs, on the east side of the entrance.

Four lanterns on posts are maintained by the U. S. Engineers, as follows:

A fixed red light on the Breakwater pier, 54 feet from the outer end and 36 feet above the lake level.

A fixed white light on the Breakwater pier, 375 feet from the outer end and 42 feet above the lake level.

These lights on range show the direction of the breakwater and the course for entering.

A fixed white light on the west pier, outer end, and 36 feet above the lake level.

A fixed red light on the Outer breakwater, east end, and $15\frac{1}{2}$ feet above the lake level.

Life-Saving Station.—There is a Life-Saving Station about 40 feet north of the lighthouse.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance bring the lights on range and stand in, keeping the Breakwater pier a little open on the port bow.

Currents.—A strong westerly current sets past the entrance to the harbor; the Breakwater pier was built as a protection against it.

Saint Joseph, Michigan, is an important harbor on the south bank of the St. Joseph River. Benton Harbor, on a canal 2 miles NE., is a thriving town. A small stream, the Paw-Paw River, empties into this canal near its junction with the St. Joseph River, $\frac{3}{4}$ mile from the lake.

Two piers have been built out from the river's mouth, the north pier being 1,000 feet long and the south pier 550 feet and the width between the piers 263 feet. The shoaling outside the harbor has at times threatened to close it.

The Benton Harbor canal is 90 to 100 feet wide. A wing dam has been constructed at the mouth of the Paw-Paw River as a protection against the sand.

The available depth in St. Joseph Harbor and in Benton Harbor canal was (January, 1894) 12 to 13 feet.

St. Joseph Light.—A fixed white light varied by a white flash every 45 seconds, visible $15\frac{2}{10}$ ($18\frac{1}{2}$) miles, is shown from a square tower on a white dwelling on a bluff in the city, SE. of the entrance.

St. Joseph Pierhead Range.—The front light near the outer end of the north pier is fixed red and 25 feet above the lake level.

The rear light, 300 feet distant, is also fixed red, visible $7\frac{1}{2}$ ($9\frac{1}{2}$) miles, and 50 feet above the lake level.

The front light is shown from a lantern in an enclosed glazed end of a conduit; the rear one from a square white tower.

These lights show the direction of the outer end of the north pier and, in range, the course for entering the harbor.

Fog Signal.—A bell struck by machinery every 30 seconds.

Signal Service Station.—There is a Signal Service Station 400 yards north of the lighthouse in the town.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the north pier.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance head in on the range with the piers, end on; as the piers are approached, open out the north pier on the port bow.

NOTE.—A sand bar has formed between the piers, its shoalest spot being near the north pier. It extends 100 feet across the channel, making the south side the better.

South Haven, Michigan, is at the mouth of Black River, a narrow stream.

The harbor is formed by two piers projecting into the lake from the mouth of the river, the north pier being 730 feet and the south pier 490 feet long from the shore line, the width between the piers 177 feet.

The main obstruction is the bar outside the piers.

Yearly dredging is necessary in the river.

July, 1893, there was a depth of 16 feet on the bar, 12 feet between the piers, and about the same in the river.

South Haven Pierhead Light.—A fixed red light, visible $8\frac{1}{2}$ ($9\frac{1}{2}$) miles, is shown from a tower, 38 feet from the outer end of the south pier.

Signal Service Station.—There is a Signal Service Station on the lighthouse reservation.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the north pier.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles west of the light, head for it. As it is approached, open it a little on the starboard bow and run in between the piers, keeping in mid-channel.

Caution.—Keep the piers end on, as there is shoal water on either side of the entrance.

Kalamazoo River, Michigan.—The towns of Saugatuck and Douglas are on opposite banks of this river, $3\frac{1}{4}$ miles from the mouth, Saugatuck being on the north bank.

The stream is one of some capacity, draining 1,700 square miles and having a natural depth of 6 to 8 feet.

Below Saugatuck is a deep bend in the river, and bordering this is a large expanse of sand extending to the lake shore. Were the drift of sand from this vicinity into the river controlled there would be no difficulty in maintaining a channel of 10 or 12 feet depth.

A north pier, extending 150 feet into the lake, is practically useless, and a south pier 220 feet long is nearly a total wreck; the piers as they stand, not extending beyond the 5-foot curve and not sand-tight, afford little aid to navigation. The width between the piers is 220 feet.

In January, 1894, the available depth outside the south pier was 7 to 8 feet. Thence to above the bend in the river are numerous bars.

Kalamazoo Light.—A fixed white light, visible $12\frac{3}{10}$ ($14\frac{3}{4}$) miles, is shown from a square tower on a white dwelling on the north side of the mouth of the river.

Kalamazoo Pierhead Light.—A fixed red lantern, is shown from an inclosed glazed end of a conduit at the outer end of the south pier.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles west of Kalamazoo light, head for the light and run in between the piers, keeping in mid-channel. None but small vessels can enter this harbor.

Holland, Michigan.—Holland (or Black) Lake is a large body of water near the eastern shore of Lake Michigan, with which it is connected, the town of Holland being at its head some 5 miles from the entrance.

The entrance channel is between piers, 215 feet apart at the entrance, diminishing to 100 feet inside.

The north and south piers are respectively 520 and 680 feet long beyond the shore line, extending west to the 10-foot curve. The 15-foot curve is 500 feet further out.

In winter the depth is usually reduced to 7 feet. The depth in Black Lake is 24 to 40 feet.

Holland Pierhead Range Lights.—A fixed red light is shown from a post on the outer end of the south pier; it is 25 feet above the lake level.

The rear light is also red, visible $8\frac{1}{2}$ ($9\frac{3}{4}$) miles and 32 feet above the lake level. It is shown from a square white tower. The lights are 102 feet apart and form a range for entering the harbor.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the south pier.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance, head in on the range. When the piers are close-to, stand in between them, keeping in mid-channel.

If not acquainted with the waters of Black Lake, it is best to anchor and get a pilot. A system of ranges is used which is said to be easily understood.

Currents.—There are no currents save those due to fluctuations in the lake level.

Grand Haven, Michigan, lying near the mouth of Grand River on its south bank, is the principal harbor of refuge on the east coast, and with this object in view, was designed with an entrance width of 390 feet and a depth of 18 feet.

Grand River is the largest stream on this coast.

Two piers have been built. The north pier has a total length of 3,187 feet and projects 1,230 feet from shore. The south pier is 5,576 feet long, projecting 1,650 feet beyond the shore line. The outer ends of the piers are nearly abreast of each other. The north pier is to be extended 350 feet and the south pier 100 feet.

There are large sand dunes on the north side of the entrance from which quantities of sand are blown into the river, and, being carried by the current, maintain a bar opposite the middle of the entrance and outside the piers. Vegetation is being cultivated on these dunes to prevent this, and catch-sand fences are also used, but only furnish temporary relief.

In January, 1894, the navigable depth on the southern crossing of the outer bar was 18 feet; the shoalest spot in front of the entrance was 14 feet; the depth between the piers near the entrance 16 feet; further inside 20 feet, as far as Grand Haven landings. For 5 miles above Grand Haven there is a depth of 10 feet, and for 10 miles further from 6 to 8 feet.

Grand Haven Light.—A fixed white light, varied by a white flash every minute, visible $13\frac{3}{10}$ (16) miles, is shown from a conical white tower on the bluff at the south side of the mouth of the river.

Grand Haven Pierhead Range.—The front light is fixed red and is exhibited from a lantern in the inclosed glazed end of a conduit, 25 feet above the lake level.

The rear light, 384 feet distant, is fixed white, visible $11\frac{3}{10}$ (13) miles, and is shown from a square white tower 37 feet above the lake level.

These two lights, on the south pier, show the direction of the piers and the course for entering the harbor.

Fog Signal.—A steam siren on the south pier in the rear of the lighthouse sounds blasts of 5 seconds duration with silent intervals of 35 seconds.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the north pier.

Wharfage.—Freight is charged wharfage here.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance, head in on the range with the south pier end on; when close-to, head between the piers, closer to the south side of the entrance until inside, when keep mid-channel.

Caution.—The greatest depth of water was, at the last notice, on the southern crossing of the bar, but this and the depth may change in a short time during a gale, so great care is necessary in entering at such times.

Currents.—During the spring months the currents in the river run from 3 to 4 miles an hour; during the summer months the currents are light.

Muskegon, Michigan, with a population of over 30,000, is on the south shore of Muskegon Lake, the largest of the interior lakes along the east coast of Lake Michigan. The Muskegon River discharges through this lake, the city being $3\frac{1}{2}$ miles from its mouth. This river is second only to Grand River in drainage area and volume, and its current keeps the harbor open the year round, except when ice is forced upon the shore by strong westerly winds.

The entrance to the lake is formed by two piers 305 feet apart, converging to 190 feet at the shore line. The north pier projects 1,260 feet and the south pier 1,300 feet beyond the shore line.

December, 1893, the depth on the southern crossing of the bar was about 20 feet and the available depth in the entrance channel $15\frac{1}{2}$ feet. The depth in Muskegon Lake is 30 to 40 feet with 15 to 20 feet at the head of the landing piers.

Muskegon Light.—A fixed white light, visible $12\frac{2}{10}$ (14) miles, is shown from a square tower on a white dwelling on the south side of the entrance about 100 yards from the lake.

Muskegon Pierhead Range.—The front light is fixed red, 25 feet above the lake level, and exhibited from a lantern in the inclosed glazed end of a conduit.

The rear light, 586 feet distant, is fixed red, visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles. It is shown from a square white tower 36 feet above the lake level.

These two lights show the range and direction of the piers.

Fog Signal.—A bell is struck by machinery one blow every 15 seconds.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the north pier.

Shoals.—In Muskegon Lake shoal water extends $\frac{3}{4}$ mile from the south shore. Booms have been built to control the flow of sand.

Bank Point Shoal.—In the middle of the north shore a shoal extends southward $\frac{1}{2}$ mile with 6 feet of water near the buoy on the outer end. It extends NE. and NW. from the buoy.

Buoy.—A black can buoy in 12 feet of water marks the extreme southern point of this shoal and also the turning point of the lake. There is no passage to the northward.

Directions for Entering Lake Muskegon.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance, head in on the range with the piers, end on at first, keeping to the south side of the bar until the piers are approached, when run in between them in mid-channel.

On leaving the channel head east (nothing to the northward) passing southward of the buoy. From here head NE. $\frac{1}{2}$ N. (N. $39^{\circ} 23'$ E.) until abreast of the docks.

Caution.—Care is necessary in entering, especially in NW. gales. Several schooners have been sunk or severely injured by colliding with the piers.

White River, Michigan.—White River flows through White Lake, a broad and capacious body of water near the coast, into Lake Michigan. Near the upper end of White Lake, about 5 miles from the entrance, there are two towns, Whitehall on the south and Montague on the north shore.

The harbor entrance is formed by two piers with a width between of 200 feet. The north pier projects 380 feet and the south pier 710 feet beyond the shore line. The north pier still lacks 250 feet of completion and the south one 200 feet. The north pier at present terminates near the 8-foot curve and after its extension will be 300 feet from the 15-foot curve. The sand is constantly shifting and the entrance is liable to be barred by heavy gales.

In August, 1893, there was a depth of 14 feet between the piers and from 25 to 60 feet in White Lake.

White River Light.—A fixed white light, varied by a red flash every 40 seconds, visible $12\frac{2}{10}$ (14) miles, is shown from an octagonal tower on the NW. corner of a dwelling, both yellow, on the south side of the entrance.

White River Pierhead Light.—A fixed red light, visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles, is shown from a square white tower on the south pier, 35 feet from the outer end.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the north pier.

White Lake Shoals.—There is a 5-foot shoal $\frac{1}{8}$ mile east of the entrance, and one mile east of that another, none, however, on the north shore extending over $\frac{1}{4}$ mile from shore.

The south shore can be approached to $\frac{1}{4}$ mile for $2\frac{1}{2}$ miles, from which point shoals extend $\frac{3}{4}$ mile from the shore as far as Whitehall.

Directions for Entering the Harbor.—When $1\frac{1}{3}$ ($1\frac{1}{2}$) miles west of the entrance head in for the Pierhead light with the piers end on; when close-to, keep between the piers in mid-channel. After passing the shoal at the entrance, by keeping $\frac{1}{4}$ mile off the north shore and following its general trend, all shoals will be avoided.

Pentwater, Michigan, is on the north shore of one of the smaller of the interior lakes.

The entrance to Lake Pentwater is formed by two piers 150 feet apart, extending into Lake Michigan. The north pier projects 650 feet and the south pier 630 feet beyond the shore line to the 10-foot curve. The channel between the piers averages a depth of 10 feet. Lake Pentwater is 25 feet deep.

A bar extending from the lighthouse on the south pier in a NW. direction frequently forms during a gale.

Pentwater Pierhead Range.—The front light is fixed red and is shown 25 feet above the lake level from a post. It is on the outer end of the south pier.

The rear light, fixed red, is visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles. It is shown from a square white tower and is 33 feet above the lake level.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the north pier.

Tugs.—There is one tug owned by the Sands & Maxwell Lumber Co., the charges being reasonable.

Directions for Entering the Harbor.—When $1\frac{1}{3}$ ($1\frac{1}{2}$) miles off the entrance, head in on the range, keeping to the NW. side of the entrance and closer to the north pier until within the entrance, when keep in mid-channel.

Ludington, Michigan, is the terminal of the Flint and Pere Marquette Railroad which maintains a fleet of lake steamers. Its inner harbor is on Pere Marquette Lake which empties into Lake Michigan south of the town. It is a port of some importance.

The harbor is formed by two piers 250 feet apart at the entrance, narrowing to 200 feet at the shore line. The north pier has a total length of 1,452 feet and projects 930 feet into the lake. The south pier is 2,381 feet long, 1,500 feet being in Lake Michigan. This latter, lying on the side of the greatest exposure, overlaps the north pier 350 feet.

The available depth in the channel between the piers is 16 feet. The depth in Pere Marquette Lake is over 40 feet.

Ludington North Pierhead Light.—A fixed white light on the outer end of the north pier is shown from a post and is 25 feet above the lake level.

Ludington Pierhead Range.—The front light is fixed red and shown from a post on the outer end of the south pier and 25 feet above the lake level.

The rear light, 106 feet distant, is a fixed red light, visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles. It is shown at a height of 36 feet above the lake level from a square, white tower.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the north pier.

Directions for Entering the Harbor.—When $1\frac{1}{3}$ ($1\frac{1}{2}$) miles off the entrance, head in on the range with the piers end on. When close to the piers, keep between them and in mid-channel.

Manistee, Michigan, is on Manistee lake and river, at their lower junction, about 8,000 feet from the eastern shore of Lake Michigan. The Manistee River, a swift, narrow stream, flows through Lake Manistee

into Lake Michigan. There are several small towns on the southern shores of Manistee Lake.

The entrance to the harbor is formed by two piers 185 feet apart, the northern one projecting 1,230 feet and the southern one 680 feet beyond the shore line.

The navigable depth in January, 1894, was 16 feet between the piers and 13 feet in the river. The depth in Manistee Lake is ample for all vessels.

Manistee Range Lights.—The front light is fixed red, $23\frac{1}{2}$ feet above the level of the lake. It is shown from a lantern in the inclosed glazed end of a conduit near the outer end of the north pier.

The rear light, fixed white, varied by a red flash every 45 seconds, and visible $12\frac{2}{10}$ (14) miles, is 45 feet above the lake level. It is shown from a square tower on a white dwelling on the north side of the mouth of the river. It is 2,022 feet ESE. (S. $67^{\circ} 30'$ E.) from the front light.

When a vessel is within 800 feet of the outer end of the north pier this light will be obscured when bearing ESE.

Fog Signal.—A steam whistle in a house on the north pier sounds blasts of 5 seconds duration with silent intervals of 25 seconds.

Life-Saving Station.—There is a Life-Saving Station on the inner end of the north pier.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance, head in on the range with the piers end on. When the piers are approached, head between them and keep in mid-channel.

Portage Lake, Michigan.—This harbor was originally designed for a harbor of refuge, being favorably situated for such purpose. Portage Lake, into which the entrance between the piers leads, measures $3\frac{1}{2}$ miles by one mile, and is close to the east coast of Lake Michigan.

Two piers project 550 feet. The width at the entrance is 370 feet.

In June, 1893, there was a narrow channel with $8\frac{1}{2}$ feet of water. The depth in Portage Lake is ample for any vessel.

Portage Lake Pierhead Range.—The front light is fixed red and is shown from a post on the outer end of the north pier at a height of 23 feet.

The rear light is fixed red, visible $11\frac{3}{10}$ (13) miles. It is shown from a square, white tower 40 feet above the lake level.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance, head in on the range. When near the piers stand in between them, keeping in mid-channel.

Frankfort, Michigan, is on Lake aux Bees Scies close to the east shore of Lake Michigan. A short channel connects the two lakes and the entrance is protected by two piers.

A line of steamers ferries freight cars across from here to Kewaunee, Wisconsin, a distance of 62 miles.

The width between the piers is 200 feet; the north pier projecting 440 feet and the south pier 870 feet beyond the shore line.

In December, 1893, there was a navigable depth of 16 feet between the piers and 15 feet on the bar. The depth in the inner lake is 20 feet.

Shoal.—From the end of the north pier an 11-foot shoal narrows the channel.

Frankfort Pierhead Light, a fixed red light, visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles, is shown from a square, white tower on the south pier 83 feet from the outer end.

Fog Bell.—A bell in a tower on the south pier, 8 feet in the rear of the light tower, is struck by machinery a double and a single blow alternately at intervals of 20 seconds.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the south pier.

Directions for Entering the Harbor.—When $1\frac{1}{3}$ ($1\frac{1}{2}$) miles west of the entrance, head for the light and run in between the piers, keeping close to the south pier until well inside, when keep in mid-channel.

Traverse City, Michigan, is at the head of the west arm of Grand Traverse Bay. There is good anchorage off the town.

There is no light under Government control.

Charlevoix, Michigan, is at the mouth of the Pine River, on the north-eastern shore of Lake Michigan.

The harbor entrance leads through Round Lake and Pine River to Pine Lake, $\frac{3}{4}$ mile back from the coast. It is formed by two piers 160 feet apart at the outside narrowing to 100 feet at the shore line, the north pier projecting 760 feet and the south pier 370 feet beyond the shore line. The available depth is 13 feet. There is a depth of 40 feet in Round Lake.

The channel from Round Lake to Pine Lake is between revetments 83 feet apart, the depth being 12 feet.

Charlevoix Pierhead Light.—A fixed red light, visible $8\frac{1}{2}$ ($9\frac{3}{4}$) miles, is shown from a square, white tower on the north pier 60 feet from the end.

Directions for Entering the Harbor.—When $1\frac{1}{3}$ ($1\frac{1}{2}$) miles off the entrance, head for the light on a course SE. by E. (S. $56^{\circ} 15' E.$) with the piers end on. When close-to, run in between the piers, keeping in mid-channel.

Little Traverse, Michigan, on the north side of Little Traverse Bay, affords well sheltered anchorage with good holding ground.

Little Traverse Light.—A fixed red light, visible $11\frac{3}{10}$ (12) miles, is shown from a square tower attached to the south end of a dwelling on the extremity of Harbor Point.

CHAPTER VIII.

PORTS ON THE WEST AND NORTH SHORES.

Waukegan, Illinois, is the first port of any size north of Chicago on the west coast.

A basin has been inclosed by piers and double lines of piling filled in with stone. The shore line along the north pier has advanced 700 feet since 1879.

The north pier extends 345 feet eastward, then 381 feet southward, then 534 feet southeastward, and then 547 feet parallel with the south pier, which extends 1,227 feet eastward. The width between the piers is 236 feet.

The depth in the channel near the north pier was (April, 1893) 11 feet.

Waukegan (Little Fort) Light.—A fixed white light, visible $12\frac{3}{10}$ ($14\frac{3}{4}$) miles, is shown from a square tower on a white dwelling on the bluff on the south side of the mouth of the Little Fort River about 300 yards from the shore line.

Directions for Entering the Harbor.—When $1\frac{1}{3}$ ($1\frac{1}{2}$) miles east of the entrance, head in for the light with the piers end on. When the piers are close-to, run in between them and nearer the north pier.

Kenosha, Wisconsin, is situated at the mouth of Pike Creek which here opens into an extensive basin. The entrance to the harbor is between two piers 150 feet apart. The north pier is 1,700 feet and the south pier 1,000 feet long. In September, 1893, there was a narrow channel about 14 feet deep.

Kenosha (Southport) Light.—A fixed white light varied by a white flash every 45 seconds, visible $14\frac{3}{10}$ ($16\frac{1}{2}$) miles, is shown from a conical, yellow tower on Warrenton Island on the north side of the entrance.

Kenosha Pierhead Range.—The front light, 28 feet above the lake level, is fixed red and shown from a lantern in the inclosed glazed end of a conduit.

The rear light, 100 feet distant, is also red and shown from a square, white tower. It is 39 feet above the lake level and visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles.

These lights form a range showing the direction of the piers.

Daymark.—N. R. Allen Sons' Tannery is an excellent leading mark when entering the harbor. The tall chimney can be seen for a distance of 18 miles and is a more prominent mark than the lighthouse.

Life-Saving Station.—There is a Life-Saving Station on the north bank of the river in rear of the lighthouse.

Tugs.—There are four companies owning tugs and the charge is \$5 apiece for vessels.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance and on the range of the lights, head in for them with the piers end on. When the piers are close-to, run between them, keeping the north pier as close aboard as possible, the best water being on that side. The inner harbor should not be entered by sailing vessels without the assistance of a tug. Vessels, however, can make fast to different points along these piers.

In ordinary weather vessels can anchor outside, where there is good holding ground.

Pilotage.—The Captain of the Life-Saving Station is always on duty and can be obtained as a pilot when desired.

Racine, Wisconsin, is an important city lying at the mouth of Root River.

The entrance to the harbor is formed by two piers, 250 feet apart at the entrance, narrowing to 160 feet at the shore line. The north pier is 1,610 feet long and the south pier 1,370 feet long. In June, 1893, there was a channel 80 feet wide and 15 feet deep.

Wind Point (Racine Point) Light is a flashing white light every 30 seconds, visible $16\frac{1}{2}$ (19) miles. In connection with this light and immediately under it is a fixed red light visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles, having an arc of illumination of $19^{\circ} 41'$ and covering Racine reef. It is visible between the bearings north and N. by W. $\frac{3}{4}$ W.

Fog Signal.—A steam whistle sounds as follows: Blast 3 seconds, silent 26 seconds; blast 5 seconds, silent 26 seconds.

Racine (Root River) Light.—A fixed white light, visible $12\frac{4}{10}$ ($14\frac{1}{2}$) miles, is shown from a square yellow tower attached to a yellow dwelling on the north pier about 800 feet from the outer end.

Racine Pierhead Light.—A fixed red light, is shown on the outer end of the north pier from a lantern at the inclosed glazed end of a conduit. With Racine (Root River) light (white) the light will guide clear to the northward of Racine reef by keeping the white light open to the northward of the red light.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the south pier.

Signal Service Station.—There is a Signal Service Station about 400 feet from the Root River lighthouse.

Racine Reef.—This dangerous reef lies ESE. $\frac{1}{2}$ E. ($S. 73^{\circ} 08' E.$) $1\frac{1}{8}$ miles from Racine lighthouse. It extends ENE. and WSW. one mile and north and south $\frac{3}{4}$ mile, with 8 feet of water over its shoalest part. The channel between the reef and the city has a depth of 3 to 6 fathoms.

Buoys.—A black can buoy in 17 feet of water marks the westerly edge.

A red spar buoy in 18 feet of water marks the eastern point.

Directions for Entering the Harbor.—If coming up the coast when $1\frac{1}{2}$ ($1\frac{1}{2}$) miles distant from the entrance keep midway between the black buoy and the shore until on the range with the piers end on, when head in, keeping midway between the piers.

If coming from the northward, keep Root River light (white) open to the northward of the Pierhead light (red).

Milwaukee, Wisconsin, is, next to Chicago, the largest city on the lake and is at the mouth of the Milwaukee River on an indentation in the west coast of Lake Michigan, called Milwaukee Bay. It has a large commerce and steamers now call there direct from Europe.

This is a harbor of refuge and will have an anchorage area, when completed, of 417 acres beyond the 18-foot curve with a maximum depth of 36 feet, the whole inclosed by a breakwater.

The 20-foot curve is $\frac{1}{2}$ mile off shore.

The breakwater begins on the north side of the bay at North Point $\frac{3}{4}$ mile SW. of Lighthouse Point in 8 feet of water and extends S. 25° E. for 2,450 feet; then S. 11° W. for 1,000 feet, at which point there is an opening of 400 feet for a fair weather entrance. Beyond this entrance the breakwater continues S. 11° W. for 800 feet.

The total length of the main arm including the opening is to be 5,200 feet.

There is a lightvessel at the south end of the breakwater.

The entrance to the river is between piers 284 feet apart at the outer end, narrowing to 260 feet further in. The north pier is 1,750 feet and the south pier 1,720 feet long.

In March, 1894, there was an available depth of $16\frac{1}{2}$ feet in the entrance channel except close to the piers. The river is 200 feet wide at the entrance and as far as the principal docks. There are no obstructions excepting the bridges, the nearest of which is 2,000 feet from the entrance. The average depth of water in the river is about 16 feet.

A Lightvessel, painted red, is moored near the southern end of the breakwater. Two lights are shown, one directly over the other, the lower light is white and the upper light red. The lower light is 30 feet above the water, the distance between the lights being 4 feet. This vessel is under the control of the U. S. Engineers.

Milwaukee Light.—A fixed white light, varied by a white flash every 45 seconds, visible $17\frac{2}{10}$ ($19\frac{1}{4}$) miles, is shown from an octagonal brown tower near the extreme north point of Milwaukee Bay.

Milwaukee Pierhead Light.—A fixed red light, visible $11\frac{3}{10}$ (13) miles, is shown from a square, white, pyramidal tower on the outer end of the north pier. The keeper's dwelling, with the tower of the discontinued light attached, is on the north pier inside this light.

Fog Signal.—A steam whistle in a house on the north pier in rear of the light sounds blasts of 5 seconds duration with silent intervals of 55 seconds.

Cribs.—North of the breakwater about $\frac{1}{2}$ mile the waterworks pile bridge pier with the old crib at the end projects from the shore, and NE. of the end is the new crib $\frac{1}{2}$ mile S. by E. from Milwaukee light.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the south pier.

Wharfage.—There are no wharfage charges for vessels. Twenty cents per ton is charged on cargoes.

Tugs.—The Milwaukee Tug Boat Line owns six tugs and the Independent Tug Boat Line two tugs. There is a published printed scale of prices for towing in Milwaukee harbor. The charges are about 5 cents per registered ton.

Directions for Entering the Harbor.—When $2\frac{1}{2}$ (3) miles east of the entrance, head west for the Pierhead light. When the entrance is close-to, stand in between the piers.

Entering the outer harbor bring the lightvessel to bear NW. distant one mile, when head west until the lightvessel bears N. by E. (N. $11^{\circ} 15'$ E.), when head north into the harbor. These directions will hold for a change of the position of the lightvessel. The distance may be shortened as the lightvessel approaches the end of the proposed breakwater.

Currents.—During fresh northerly winds there is a current along the shore setting from north to south across the harbor entrance.

Port Washington, Wisconsin, lies 25 miles north of Milwaukee, at the mouth of the Sauk River.

The harbor consists of an inclosed, dredged basin of $5\frac{1}{2}$ acres in area, with two arms; one running north, 800 feet long and 200 feet wide, and the other running west, 500 feet long and 150 feet wide. The Sauk River empties into the lake south of the south pier.

The entrance is between piers 150 feet apart, the north pier being 920 feet and the south pier, with the revetments inclosing the west basin, 1,326 feet long. In May, 1893, the depth in this channel was $10\frac{1}{2}$ feet.

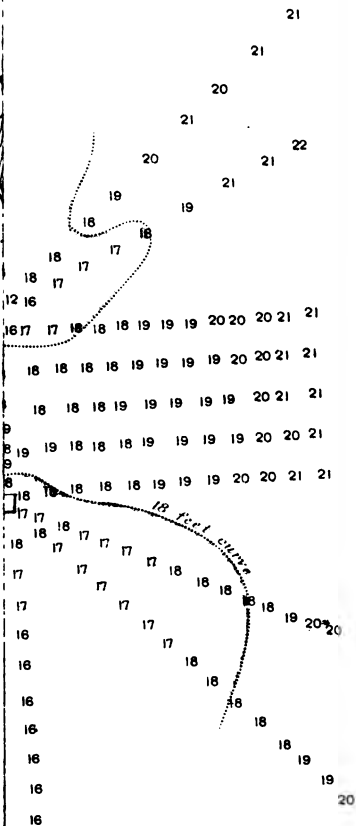
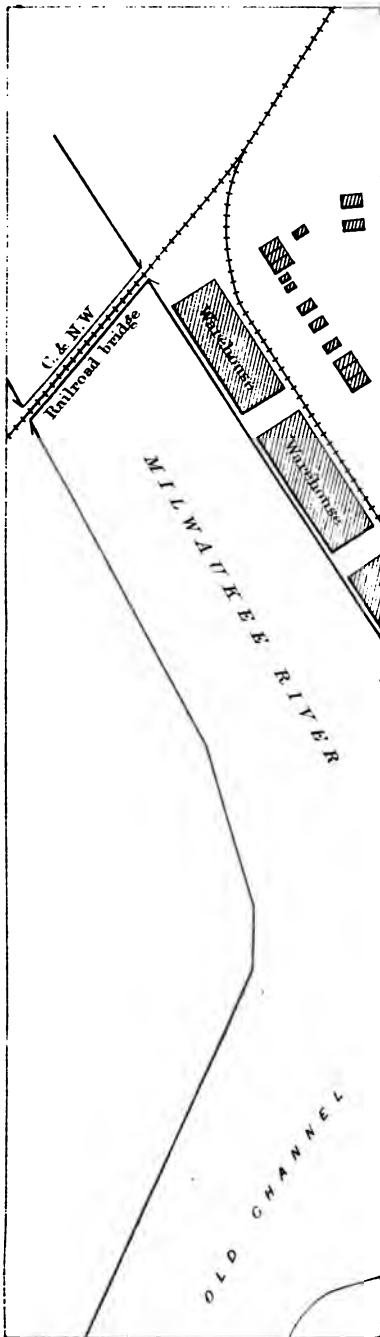
The depth of the north basin was (March, 1893) $10\frac{1}{2}$ to 12 feet, with 10 feet or less near the NW. end.

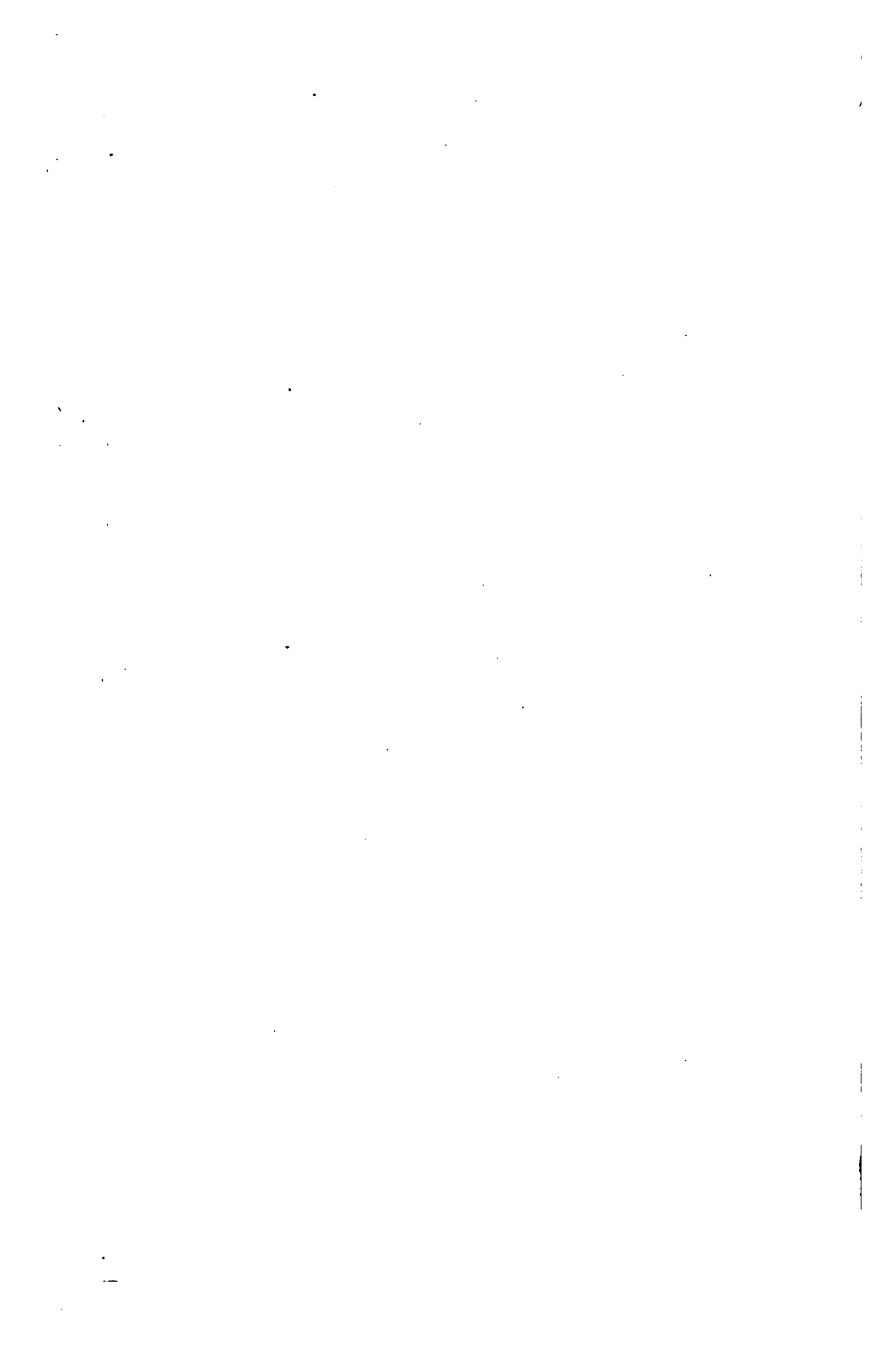
The northern half of the west basin had, at the same time, 10 to 12 feet of water, the southern half 6 feet or less.

A short distance north of the entrance is an old landing pier, now abandoned.

Port Washington Light.—A fixed white light, visible $16\frac{1}{2}$ (19) miles, is shown from a square tower on a yellow dwelling on the bluff in the northern part of the town.

The datum is the zero of the water-gauge at the west end of North Pier, 6.835 feet below the permanent bench-mark on the water table at the S.W. corner of Shea's brick warehouse, and 3.324 feet below high water of 1838, (U.S. Lake Survey plane of reference)





Port Washington Pierhead Light.—A fixed red light, visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles, is shown from a square white tower on the outer end of the north pier.

Wharfage.—There is a city ordinance to collect dockage on freight discharged or received at the foot of streets or alleys running to the harbor.

Tugs.—There is one fishing tug which, when in port, will take vessels in and out of port for a moderate charge.

Directions for Entering the Harbor.—When off the entrance, bring the Pierhead light west and stand in for it with the piers end on. When the piers are close-to, keep between them, changing course on passing the foundry as desired.

Sheboygan, Wisconsin, is on the north side of the mouth of the Sheboygan River.

The entrance to the river is between piers 270 feet apart outside, narrowing to 170 feet at the shore line. The north pier is 2,370 feet and the south pier 2,487 feet long. The least depth of water is $15\frac{1}{2}$ feet.

The river turns to the SW. from the entrance, and forms a deep bight south of the main portion of the city.

There is a winding basin 400 feet in width at the mouth of the river, and the average width of the river is 220 feet, increasing to 269 feet at the first bridge, about 2,200 feet from the mouth.

The depth in the river is $15\frac{1}{2}$ feet.

Sheboygan Light.—A fixed white light, visible $12\frac{8}{10}$ ($14\frac{3}{4}$) miles, is shown from a square tower on a white dwelling on a point one mile north of the entrance.

Sheboygan Pierhead Range.—The front light, fixed red, is shown from a lantern in the inclosed glazed end of a conduit 23 feet above the lake level.

The rear light, 270 feet distant, is fixed red, visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles, and shown from a square white tower 32 feet high. Both are on the north pier.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the north pier.

Signal Service Station.—There is a Signal Service Station on the lighthouse reservation.

Tugs.—The Sheboygan Tug Line charges 3 to 4 cents per ton for actual load carried.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles east of the entrance, head in on the range. When the piers are close-to, stand in between them.

Reef.—A rocky reef, with 7 feet least water on it, lies $\frac{1}{8}$ mile NE. $\frac{1}{8}$ N. (N. 43° $36'$ E.) from the end of the harbor pier. The reef is 600 yards long north and south. There is a narrow passage 300 yards wide between it and the shore. Strangers should not attempt it.

Buoys.—A red can buoy in 24 feet of water marks the south end.

A red can buoy in 24 feet of water marks the NE. end.

Manitowoc, Wisconsin, is built up on both sides of the mouth of the Manitowoc River.

The entrance to the river is between piers, 240 feet apart at the outer end, narrowing to 220 feet inside, the north pier being 1,970 feet and the south pier 1,900 feet long.

In April, 1893, the depth between the piers was $14\frac{1}{2}$ feet in mid-channel.

Manitowoc Pierhead Light.—A fixed red light, visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles, is shown from a square white tower on the outer end of the north pier.

The old lighthouse is near the inner end of the same pier.

Fog Signal.—A bell is struck by machinery a double blow every 30 seconds.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance, with the pierhead light bearing west, head for it. When the piers are close-to, keep in mid-channel.

Two Rivers, Wisconsin, is an enterprising little city on the SE. side of Rawleys Point, and has an excellent harbor, formed by the junction of East and West Twin rivers. In the fall of 1893 the city dredged the inside harbor to a depth of 10 to 12 feet. The rivers are navigable for 3 miles from the mouth.

The entrance is between piers 240 feet apart, the north pier being 1,810 and the south pier 1,710 feet long.

In August, 1893, there was a channel midway between the piers, 120 feet wide and 12 feet deep.

Two Rivers Pierhead Light.—A fixed red light, visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles, is shown from a square pyramidal tower on the outer end of the north pier.

Life-Saving Station.—There is a Life-Saving Station near the inner end of the east pier.

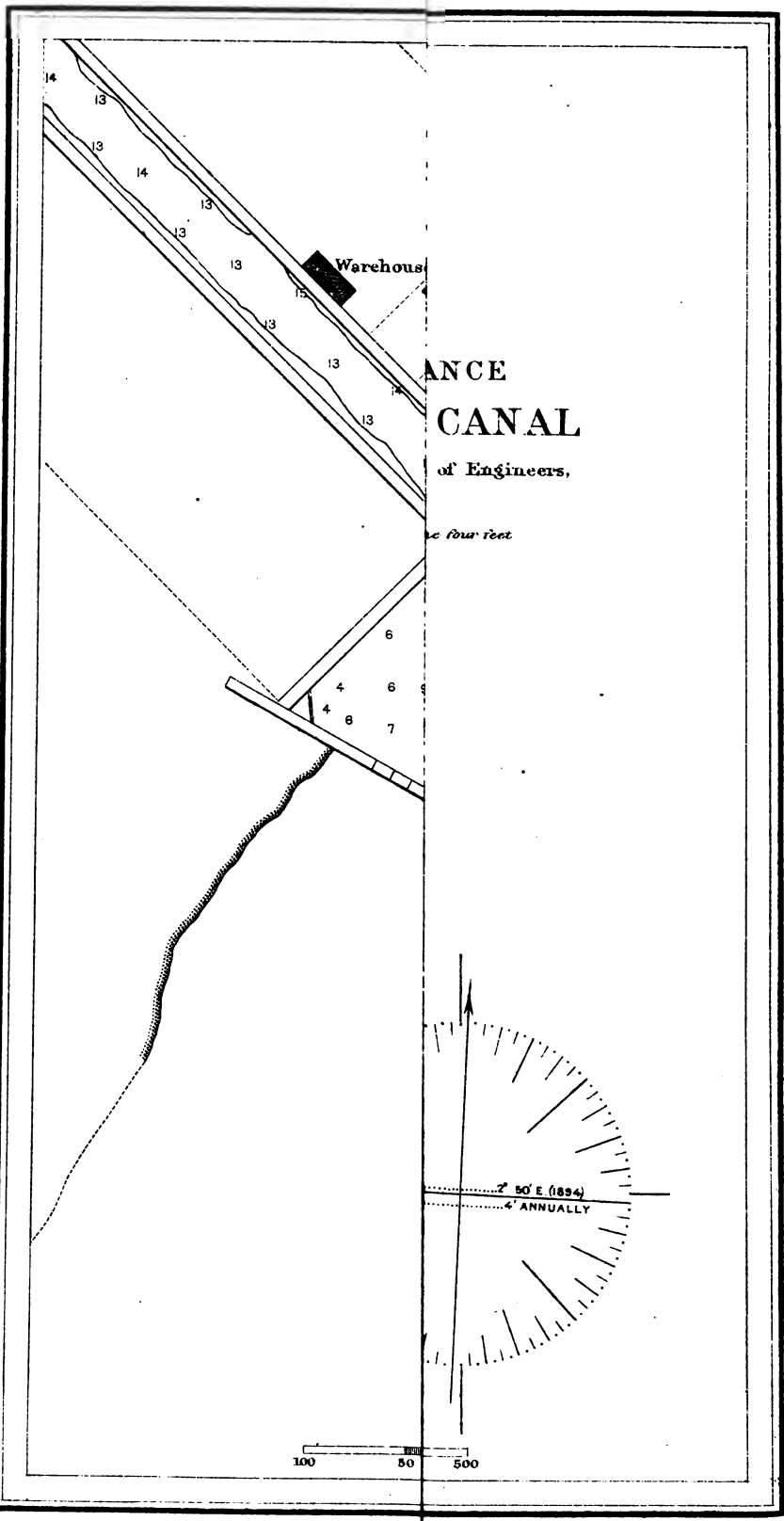
Tugs.—Tugs are owned by four different parties. Competition is strong and charges moderate. The tugs are so much engaged in fishing and towing rafts that they are not always obtainable.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance, bring the Pierhead light to bear NW. (the piers run NW. and SE.) and head in. When the piers are close-to, keep between them in mid-channel.

Twin River Point Light is fixed white varied by a white flash every 30 seconds. It is shown from a conical white tower connected with a white dwelling and visible $16\frac{1}{2}$ (19) miles.

Fog Signal.—A steam whistle sounds as follows: Blast 5 seconds, silent 10 seconds; blast 5 seconds, silent 40 seconds.

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Kewaunee, Wisconsin, is on the south side of the Kewaunee River.

The entrance to the river is through a channel 300 feet wide at the point where the river bends to the north. The lake end of the channel is protected by two piers 200 feet apart, the north pier being 1,500 feet and the south pier 1,425 feet long.

In September, 1893, there was a depth of 14 feet in mid-channel with a width of 120 feet.

A basin 450 feet long and 11 to 12 feet deep, both the same width as the entrance channel, has been formed in the old river bed to the northward of the entrance.

Kewaunee Pierhead Range.—The front light is fixed red, and shown from a lantern in an inclosed glazed conduit. It is 23 feet above the lake level.

The rear light, also red, is $42\frac{1}{2}$ feet high, and visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles. It is shown from a square, white, pyramidal tower. Both are on the north pier.

Directions for Entering the Harbor.—When $1\frac{1}{3}$ ($1\frac{1}{2}$) miles ESE. of the entrance, head in on the range. When the piers are close-to, keep in mid-channel.

Caution.—If approaching from the northward be careful of the rocks north of the entrance.

Ahnapee, Wisconsin, is at the mouth of the Ahnapee River on both banks.

The entrance is between piers, 200 feet wide at the entrance, narrowing to 125 feet further in. Each pier is 1,100 feet long. There is a bridge over the river about 1,000 feet inside of the present shore line.

In July, 1892, $11\frac{1}{2}$ feet could be carried through the entrance channel, which was 100 feet wide, but from the inshore end to the bridge only 9 feet. The bottom being rocky, care is necessary in navigating.

Ahnapee Pierhead Range Lights.—The front light is fixed red, and shown from a post 22 feet above the lake level.

The rear light is also red, visible $6\frac{1}{10}$ (7) miles. It is shown from a square, white, pyramidal tower. Both on the north pier.

Directions for Entering the Harbor.—When $1\frac{1}{3}$ ($1\frac{1}{2}$) miles SE. of the entrance, head in on the range. When the piers are close-to, run between them in mid-channel until the shore line is reached, when keep to the southern side of the channel to the bridge.

HARBOR AT THE ENTRANCE OF STURGEON BAY CANAL, WISCONSIN.

This entrance to the canal leading from Lake Michigan to Sturgeon Bay is a harbor of refuge, though too limited in area and too unprotected to be very efficient. The village of Portage is a short distance to the northward.

In shape the harbor is triangular, being bounded by two converging piers 850 feet apart at the shore line and 230 feet apart at the outer end. The piers are 1,125 feet long. Beyond the piers on either side are detached portions of crib work 150 feet long connected with the main piers by fender piling. The inclosed area is nearly 10 acres.

April, 1893, 14½ feet could be carried into the harbor for a space 100 feet wide midway between the piers. From here the depth shoals gradually toward the NW. and SW. angles where but 5 feet of water is found.

Sturgeon Bay Canal is 100 feet wide and 7,200 feet long. From the east end the revetments extend 4,453 feet on the north side and 3,990 feet on the south side. In November, 1893, it was dredged to 13½ feet through the canal and for 6,100 feet into Sturgeon Bay. Vessels cannot tie up in the canal but must continue on to Sturgeon Bay.

For a description of the western end of the canal, see Chapter IX.

Sturgeon Bay Canal Pierhead Light.—A fixed red light, visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles, is shown from a square, white, pyramidal tower on the outer end of the north pier.

Fog Signal.—A steam whistle in a house in the rear of the light tower sounds blasts of 5 seconds duration with silent intervals of 25 seconds.

Life-Saving Station.—There is a Life-Saving Station about $\frac{1}{4}$ mile from the light.

Directions for Entering the Harbor.—When $1\frac{1}{2}$ ($1\frac{1}{2}$) miles off the entrance, bring the Pierhead light to bear NW. and stand in for it. When the piers are close-to, keep in mid-channel.

Note.—Passing from the canal into Sturgeon Bay remember that the bay opens NW. and is buoyed accordingly.

Bailey Harbor, Wisconsin, a deep natural harbor, offers protection from all but south winds. The deep water portion is $1\frac{3}{4}$ miles long by $\frac{3}{4}$ mile wide. At the head of the harbor are the range lights, and this range will carry in safety to the anchorage off Bailey Harbor in $3\frac{1}{2}$ fathoms of water.

Bailey Harbor Range Lights.—The front light is fixed white, visible $9\frac{1}{2}$ (11) miles, and is shown from a white frame tower on the north shore.

The rear light is also fixed white, visible $11\frac{2}{10}$ (13) miles, and is shown from a square tower on a white dwelling 950 feet N. by W. $\frac{1}{2}$ W. (N. $16^{\circ} 53'$ W.) from the front light. The two form a range N. by W. $\frac{1}{2}$ W. (N. $16^{\circ} 53'$ W.) leading into the harbor. The lights are 950 feet apart.

Daymark.—A white tower (formerly a lighthouse) on the point on the east side of the entrance serves as a daymark on entering the harbor.

Directions for Entering the Harbor.—Stand in on the range N. by W. $\frac{1}{2}$ W. (N. $16^{\circ} 53'$ W.). If beating in, when north of the black spar buoy do not bring it to bear south of S. by W. (S. $11^{\circ} 15'$ W.) until a mile to the northward of it. Having passed the red buoy keep $\frac{1}{4}$ mile west of a

line joining it and the white tower. The west shore can be approached to $\frac{1}{2}$ mile excepting the point making out opposite the white tower. The best holding ground is on the east side of the bay.

The Middle Ground Shoal, at the mouth of the harbor, is $\frac{7}{8}$ mile north and south and $\frac{1}{2}$ mile east and west. It is a rocky shoal with 14 feet over the southern end and 7 feet on the northern.

The SE. end is marked by a black spar buoy in 18 feet of water.

The Eastern Shoal makes out to the southward for one mile. It is $1\frac{1}{2}$ miles wide with 13 feet on its SW. end and 15 on its SE. end.

Buoy.—A red spar buoy in 18 feet of water marks the SW. point.

Manistique, Michigan, the only town of any importance on the northern coast, is near the mouth of the Manistique River.

Piers have been built in a direction across the natural channel, and are maintained at the mouth of the river by private parties.

In May, 1892, there was a navigable channel 12 feet deep and 150 feet wide between the piers with 10 feet on the outer bar.

CHAPTER IX.

PORTS IN GREEN BAY.

Escanaba, Michigan, is on the western shore of Little Bay de Noquette at the upper end of Green Bay on Sand Point. It affords sheltered anchorage from west, SW., and south winds. There is no inner harbor.

Shoals extend off Sand Point, the extreme point being marked by a buoy.

Buoy.—A black spar buoy NE. by E. $\frac{1}{2}$ E. (N. $61^{\circ} 52'$ E.) $\frac{3}{8}$ mile from the light marks the NE. point. It is in 18 feet of water.

Escanaba Light.—A fixed red light, visible $11\frac{3}{10}$ (13) miles, is shown from a square tower attached to a white dwelling, both with red roofs. It is near the end of Sand Point.

Round the black buoy about $\frac{1}{8}$ mile distant and do not pass between it and the shore.

Cedar River, Michigan, is situated on the western shore of Green Bay at the mouth of Cedar River.

The entrance to the river is between piers 200 feet apart, running nearly SSE. and NNW., the eastern pier being 754 feet, and the western pier 301 feet in length. Work was suspended by the government in 1885 and has not been resumed since, though private parties have done some dredging. In May, 1892, there was a channel 20 feet wide and 11 feet deep, and one 9 feet deep, with a least width of 40 feet. Dredging was then in progress.

Cedar River Light.—A fixed white light, visible $13\frac{7}{10}$ ($15\frac{1}{4}$) miles, is shown from a square, white, pyramidal tower near the outer end of the east pier.

Cedar River Range.—The front light, fixed red and 21 feet above the lake level, is shown from a lantern on the south corner of Cedar River light tower.

The rear light, fixed red and $26\frac{1}{2}$ feet above the lake level, is 500 feet from the front light and shown from a post attached to an elevated walk near the light tower.

Rock.—A rock with 13 feet of water over it lies S. $\frac{1}{4}$ W. (S. $2^{\circ} 49'$ W.) from the light tower.

Buoy.—A black spar buoy in 14 feet of water marks this rock.

Directions for Entering the Harbor.—Head in on the range, then keep between the piers. Deep water can be kept by not bringing Cedar River light to bear north of N. by W. $\frac{1}{2}$ W. (N. $16^{\circ} 53'$ W.).

Menominee, Michigan, is on the north side of Menominee River, the towns of Marinette and Menekaunee being on the south bank. The mouth of the river is wide but shallow.

Good anchorage can be found outside and NW. of the light.

The entrance to the harbor is between piers, running nearly ENE. and and WSW., 360 feet apart, the north pier being 1,850 feet and the south pier 2,710 feet long, the ends nearly abreast.

There was (January, 1894) a channel 200 feet wide and 15 feet deep between the piers and this depth extended up the river 1,000 feet further. From this point to the bridge $13\frac{1}{2}$ feet will be found in several places and at the south draw less than 13 feet. From the bridge 13 to 14 feet of water can be carried for nearly 5,000 feet further up.

Menominee Pierhead Light.—A fixed red light, visible $11\frac{1}{10}$ ($12\frac{1}{4}$) miles, is shown from an octagonal, white, pyramidal tower on the outer end of the north pier.

Shoals.—There are extensive shoals to the southeastward of the light.

Directions for Entering the Harbor.—When off the entrance bring the light to bear SW., and stand in between the piers, keeping in mid-channel. If passing the bridge use the north draw.

Green Bay, Wisconsin, lies at the south end of Green Bay at the mouth of the Fox River, a very important stream. The town of De Peré is situated about 5 miles above Green Bay on the same river.

The head of Green Bay is full of shoals, but a channel has been dredged and revetted up to the city, cutting through Grassy Island. The project calls for a channel 16 feet deep, 200 feet wide, and 16,500 feet long.

In June, 1892, a channel 14 feet deep, 200 feet wide, and 11,600 feet long was completed, the cut through Grassy Island being revetted. In September, 1893, 10,200 feet of channel for a width of 100 feet was dredged to 16 feet in depth.

The available depth at the close of the fiscal year 1893 was 14 feet.

Tail Point Light.—A fixed white light, visible 13 (15) miles, is shown from a square tower on a white dwelling near the south end of Long Tail Point, about $3\frac{1}{2}$ ($4\frac{1}{2}$) miles north of the mouth of Fox River.

Fog Signal.—A bell is struck by machinery one blow every 10 seconds.

Grassy Island Upper Light.—A fixed white light, visible $11\frac{3}{10}$ (13) miles, is shown from a white tower on the piling at the south end of the east side of the new cut through Grassy Island.

Grassy Island Lower Light.—A fixed white light, visible $10\frac{4}{10}$ ($12\frac{1}{4}$) miles, is shown from a white tower on the piling at the north end of the east side of the new cut through Grassy Island.

The keeper's dwelling is on the island and between the lights.

Caution.—The distance between the two latter lights is 676 feet; **they are not range lights**; if used as such they will lead ashore. They only mark the position of the piling.

Buoys.—From off Long Tail Point and running up Fox River entrance the following buoys are passed:

Long Tail Point, a red can buoy (No. 2) in 16 feet of water, marks the SW. point of the shoal off Long Tail Point and is the first buoy as the mouth of Fox River is approached. Keep it to starboard.

Sable Point, a black nun buoy (No. 1) in 15 feet of water, marks the end of the spit which extends in a westerly direction 3 ($3\frac{1}{2}$) miles from Sable Point. Keep it to port.

Outer buoy (new cut), a red spar buoy (No. 4), in 12 feet of water, marks the west side of the outer entrance into the new cut through Grassy Island. Keep it to starboard.

Second buoy (new cut), a red spar buoy (No. 6), in 12 feet of water, marks the west channel bank of the new cut between the outer entrance buoy and Grassy Island lighthouse. Keep it to starboard.

Third buoy (new cut), a red spar buoy (No. 8), in 12 feet of water, marks the west channel bank inside of Grassy Island upper lighthouse. Keep it to starboard.

Fourth buoy (new cut), a red spar buoy (No. 10), in 12 feet of water, marks the west channel bank. Keep it to starboard.

Fifth buoy (new cut), a red spar buoy (No. 12), is in 14 feet of water at the turn in the cut.

Sixth buoy (new cut), a red spar buoy (No. 14), is in 14 feet of water, about 1,000 feet S. by W. from the fifth buoy.

Seventh buoy (new cut), a red spar buoy (No. 16), is in 14 feet of water.

Inner buoy (new cut), a red spar buoy (No. 18), is in 14 feet of water and marks the inner end of the new cut at the mouth of the river.

From Green Bay City to De Peré, Wisconsin, there are twelve (12) red spar buoys, numbered with even numbers from 2 to 24 inclusive, marking the west line of the channel of Fox River.

Directions for Entering the Harbor.—From the point one mile SE. (S. 45° E.) of Long Tail Point lighthouse, steer SW. by W. $\frac{1}{2}$ W. (S. 61° $53'$ W.) leaving buoy No. 2 on the starboard hand close-to, and when buoy No. 1 bears a little abaft the beam steer S. $\frac{1}{2}$ W. (S. 1° $24'$ W.) for the outer entrance buoy of the new cut; then as this buoy is approached, pass it to the eastward close-to, steering SSW. (S. 22° $30'$ W.), which course will lead fair into the cut. Follow the buoys until the deep water at the mouth of the river is reached and the inner buoy (No. 16) is passed; then take mid-channel for Green Bay City.

NOTE—NE. gales usually raise the water at the mouth of the Fox River from one to 2 feet and SW. gales lower it about the same.

Sturgeon Bay, Wisconsin.—This bay runs SSE. indenting the east shore of Green Bay just opposite Peshtigo Point. It affords excellent anchorage and is the real harbor of refuge to which the artificial harbor and canal (on the west shore of Lake Michigan) give access.

The town of Sturgeon Bay is on the east shore near the head of the bay about $4\frac{1}{2}$ (5) miles from the mouth and $3\frac{1}{2}$ (4) miles from the SE. entrance of the canal.

A high hill, called Stevens Hill, rises back of the town. At least 18 feet of water will be found in the center of the bay.

Sherwood Point Light.—A fixed white light, varied by a red flash every minute, visible $13\frac{1}{10}$ ($15\frac{1}{2}$) miles, is shown from a square tower attached to the north end of the dwelling, both of red brick, on the south point of the entrance to Sturgeon Bay.

Fog Signal.—A bell on Sherwood Point is struck by machinery a single blow every 12 seconds.

Dunlap Reef Range.—The front light is fixed white and is shown from a red tower attached to a white house with a red roof. It is visible $9\frac{3}{10}$ ($10\frac{1}{2}$) miles and is 18 feet above the lake level.

The rear light, also fixed white, is shown from a square tower on a white dwelling, both with red roofs. It is visible $11\frac{1}{2}$ ($13\frac{1}{2}$) miles and is 39 feet above the lake level.

The lights are on Dunlap reef, and are 680 feet apart on a range SSE. $\frac{1}{2}$ E. (S. $28^{\circ} 08'$ E.). They guide through a narrow channel abreast of Hills Point.

Shoals.—There are numerous shoals in this bay, but they are marked by buoys and lights.

Quarry Point Shoal is off the entrance to Sawyers Harbor (south of Sherwood Point); there is but 6 feet of water over it.

Buoy.—A red spar buoy marks the east side.

Hills Point Shoal.—Shoal water here extends nearly across the bay from the east shore, leaving a narrow channel between it and Hills Point and is marked by the following buoys:

Hills Point (outside), a black spar buoy (No. 1) in 15 feet of water, marks the western edge of the above shoal and is 340 yards SE. $\frac{1}{4}$ E. from Hills Point.

Hills Point, a black nun buoy (No. 3) in 14 feet of water, marks the western edge of the same shoal and is 520 yards SE. $\frac{1}{4}$ S. from Hills Point.

Hills Point (inside), a black spar buoy (No. 5) in 14 feet of water, marks the SW. point of the same shoal and is 650 yards SE. $\frac{1}{2}$ S. of Hills Point.

Dunlap Reef or Middle Ground Shoal.—This shoal lies in mid-channel NW. of the town and west of Stevens Hill. Dunlap Reef lights are on this middle ground.

Buoys.—**Middle Grounds**, (NW. end), a red and black horizontally striped spar buoy, marks the NW. end of the shoal and is 380 yards S. by E. $\frac{1}{4}$ E. (S. $14^{\circ} 04'$ E.) from Dunlap Range light (front).

West Channel, No. 1, a black spar buoy in 12 feet of water, marks the west point of the middle ground and is a guide through the West Channel. It lies 500 yards S. $\frac{1}{4}$ E. (S. $2^{\circ} 49'$ E.) from the preceding buoy.

East Channel, No. 2, a red spar buoy in 18 feet of water, marks the NE. edge of the middle ground and is a guide through the East Channel. It lies 260 yards SE. $\frac{1}{4}$ E. (S. $47^{\circ} 49'$ E.) from the buoy on the NW. end.

Middle Ground (SE. end), a red and black horizontally striped buoy marks the SE. point of the middle ground. Dunlap Reef Range light (rear) bears NNW. (N. $22^{\circ} 30'$ W.) 260 yards distant.

Directions for Entering the Bay.—When off the entrance with Sherwood Point light bearing SW. by S. (S. $33^{\circ} 45'$ W.) distant one mile, steer S. by E. $\frac{1}{2}$ E. (S. $16^{\circ} 53'$ E.) keeping at least $\frac{1}{2}$ mile off shore until past the eastern end of Sherwood Point, when steer south until past Quarry Point buoy (do not go to the westward of this buoy). Bring the Dunlap Reef lights in range and stand on past the black buoys off Hills Point (these mark the east side of the channel).

When nearly up to the Middle Ground buoy (NW. end) open the lights and pass to the **eastward** of them through the drawbridge.

Then keep nearly in mid-channel until the entrance to the canal is reached.

There is good water in the channel to the westward of Dunlap reef, but the turn around the southern end is too sharp for vessels bound through the canal.

CHAPTER X.

STRAITS OF MACKINAC.

STRAITS OF MACKINAC.

The Straits of Mackinac on the $45^{\circ} 50'$ parallel, between Point Detour and the NE. point of the Lower Peninsula of Michigan on the east, and Waugoshance light and Point aux Chênes on the west, are $41\frac{1}{2}$ (48) miles long. At the eastern and western entrances between the points mentioned the Straits are respectively $22\frac{3}{4}$ ($26\frac{1}{2}$) and 11 ($12\frac{3}{4}$) miles wide, but contracted in the Straits proper to $4(4\frac{1}{2})$ miles in width between Point St. Ignace on the north, and Mackinac lighthouse on the south. It is here further narrowed by Graham Shoals on the north shore; these shoals are marked by buoys, and are not in the direct route of vessels using the south channel; vessels using the north channel must pass south of the red bell buoy on the south shoal.

The north shore of the Straits is much indented by bays and lined by islands. There are several offlying shoals, but the water is deep close-to, and they offer no serious obstructions to navigation, being out of the direct track.

The south shore of the Straits is comparatively free from indentations. Shoal water extends some $4(4\frac{1}{2})$ miles WNW. from the extremity of Waugoshance Point; the outer extremity of this shoal being marked by Waugoshance lighthouse.

The water in the Straits is generally deep, and the shoals lying near the usually traveled routes are marked by lighthouses, lightvessels or buoys.

ROUTES.

Point Detour to Duck Island Light.—With the buoy on range with Point Detour light, and distant $\frac{1}{2}$ mile, a course SE. by E. $\frac{1}{4}$ E. (S. $59^{\circ} 03' E.$) for $44(50\frac{1}{2})$ miles, will bring Duck Island light abeam to port, distant $3\frac{3}{4}$ ($4\frac{1}{2}$) miles.

Point Detour to Presqu' Ile Light.—With the buoy on range with Point Detour light, and distant $\frac{1}{2}$ mile, a course SSE. $\frac{1}{4}$ E. (S. $30^{\circ} 56' E.$) for $39\frac{1}{2}$ ($45\frac{1}{2}$) miles, will bring Presqu' Ile light abeam to starboard, distant $4(4\frac{1}{2})$ miles.

Point Detour to Cheboygan.—With the buoy on range with Point Detour light, and distant $\frac{1}{2}$ mile, a course SW. $\frac{1}{8}$ W. (S. $46^{\circ} 24' W.$)

for $14\frac{1}{2}$ ($16\frac{3}{4}$) miles, will bring Spectacle Reef light abeam to port, distant $\frac{1}{2}$ mile. Thence SW. by W. $\frac{3}{8}$ W. (S. $63^{\circ} 16'$ W.) $14\frac{1}{2}$ ($16\frac{3}{4}$) miles, passing southward of Poe Reef lightvessel, to a point $\frac{1}{2}$ mile NNE. $\frac{1}{8}$ E. (N. $32^{\circ} 20'$ E.) from the Crib light off Cheboygan, then follow directions for entering that harbor.

Piont Detour to Waugoshance Light.—With the buoy on range with Point Detour light, and distant $\frac{1}{2}$ mile, a course WSW. $\frac{1}{2}$ W. (S. $73^{\circ} 07'$ W.) for $23\frac{1}{2}$ (27) miles, will carry a vessel to Bois Blanc light abeam, distant $1\frac{1}{2}$ ($1\frac{3}{4}$) miles. Thence W. $\frac{3}{8}$ N. (N. $85^{\circ} 46'$ W.) $7\frac{1}{2}$ ($8\frac{3}{4}$) miles to the channel between Mackinac and Round Islands.

With the red buoy in this channel abeam to starboard a course WSW. $\frac{3}{8}$ W. (S. $71^{\circ} 43'$ W.) for $5\frac{1}{2}$ ($6\frac{1}{2}$) miles, will bring Old Mackinac Point light abeam, distant $1\frac{1}{2}$ ($1\frac{3}{4}$) miles. Thence W. $\frac{1}{4}$ S. (S. $87^{\circ} 11'$ W.) for $14\frac{1}{2}$ (17) miles to abeam of Waugoshance light, distant $\frac{1}{4}$ mile. From this latter position a course can be shaped to any port on Lake Michigan.

NORTH SHORE.

From Point Detour the north shore trends in a westerly direction for nearly $37\frac{1}{2}$ (44) miles, then it abruptly changes its direction to nearly south for $12\frac{1}{2}$ (14) miles to Point St. Ignace. From Point St. Ignace to Point aux Chênes the coast is clear of danger at the distance of a mile excepting the Graham shoals.

Point Detour is a long, narrow peninsula forming the SW. entrance to Detour passage. There are 18-foot patches at $\frac{1}{4}$ mile SW. and SE. of the point, the latter being marked by a buoy.

Detour Light.—A fixed, white light, visible $14\frac{1}{2}$ ($16\frac{1}{2}$) miles, is shown from a white, skeleton, iron tower with a stair cylinder. The tower is connected with a frame dwelling by a covered way.

It marks the west side of the entrance to the St. Marys River.

Fog Signal.—There is a fog signal building 50 feet east of the light. A 10-inch steam whistle gives a blast of 8 seconds duration, followed by a silent interval of 52 seconds.

Point St. Vital is $3\frac{1}{2}$ (4) miles west of Point Detour, the shore between receding to the northward, forming a large bay open to the southward. In the NE. part of this bay is Carlton Bay, which might afford protection to small craft from northerly winds. Seven (8) miles from Point St. Vital is Beaver Tail Point. There are several outlying shoal patches here, and the shore should not be approached within $1\frac{1}{4}$ ($1\frac{1}{2}$) miles. One and one-half ($1\frac{3}{4}$) miles west of Point St. Vital is Saddlebag Island, and $2\frac{3}{4}$ ($3\frac{1}{4}$) miles further westward Albany Island.

Martin Reef is a rocky shoal having 7 feet least water, with shoals all around; the SE. end of this reef is $3\frac{1}{2}$ (4) miles S. by E. $\frac{1}{4}$ E. (S. $19^{\circ} 41'$ E.) from Beaver Tail Point, and $6\frac{1}{4}$ ($7\frac{1}{4}$) miles WSW. $\frac{1}{4}$ W. (S. 70°

18' W.) from Point St. Vital. The reef extends one ($1\frac{1}{4}$) miles north-westerly, with deep water between the shoal patches. It is a menace to navigation, as it lies nearly in the track of vessels bound from Detour Passage to the channel between Mackinac and Round Islands.

Between Martin reef and the mainland in a northwesterly direction are Tobin reef, Surveyors reef, and other patches with channels between; none of these channels should be attempted by strangers.

Buoy.—A first-class can buoy, painted black, is moored off the SE. end of Martin reef in 20 feet of water. Vessels should pass south of this buoy.

Coast.—Between Beaver Tail Point and Point Fuyards, $8\frac{3}{4}$ (10) miles to the westward, is a large indentation in which are several large and small islands, the principal of which are Strong, Boot, Ile la Salle and Ile Marquette, the latter a large island with Marquette Bay on its NW. side. Amongst these islands are many inlets (Scammon harbor being the largest), but on account of offlying shoals they are practically useless, except for small craft.

Goose Island, $2\frac{1}{4}$ ($2\frac{1}{2}$) miles WSW. of Point Fuyards, is surrounded by shoals; a reef extending for over one mile SSE. from its SE. end. From the eastern side shoals extend out $\frac{1}{2}$ mile with deep water between them and Marquette Island. From the western side shoals extend off nearly $\frac{3}{4}$ mile westerly and southwesterly; this side of the island should not be approached within a mile.

Reef.—At $2\frac{1}{2}$ (3) miles SW. by W. $\frac{1}{2}$ W. (S. 61° $52'$ W.) from Goose Island is a 6-foot patch with a 9-foot patch a short distance north of it. This reef is $\frac{1}{2}$ mile long north and south, and $\frac{1}{3}$ mile in breadth, being nearly circular in shape. It should be carefully avoided in navigating this part of the Straits.

Point Brulée.—Between the NW. shore of Ile Marquette and Point Brulée is an indentation forming Marquette and other bays; at the head of Marquette Bay is the village of Hessel. There is deep water in these bays, with many shoal spots, and they are only suitable for small craft.

Search Bay.—West of Point Brulée the shore recedes, forming Search Bay, open to the southward, its western boundary being Point St. Martin. The bay has deep water, no offlying dangers, and would serve as a shelter from northerly winds.

Point St. Martin is steep-to, and has a deep water channel between it and a rocky shoal extending east and west one ($1\frac{1}{4}$) mile in a direction parallel to the face of the point.

St. Martin Bay.—Between Point St. Martin and Gross Point is St. Martin Bay, a large bay, free from shoals, and with deep water; it is protected from all winds from east to south by way of north, and from SE. winds partially by Ile St. Martin and Grosse Ile St. Martin; between these islands and the mainland are three channels into the bay, all having

deep water. There are several rivers flowing into this bay at its head, the largest being the Pine and Carp rivers.

Ile St. Martin, circular in shape, over a mile in diameter, lies $1\frac{1}{2}$ ($1\frac{1}{2}$) miles to the westward of Point St. Martin, the channel between being perfectly safe if a mid-channel course is kept.

From the south and SW. sides of this island, shoal water extends out for nearly a mile, and these sides of the island should be given a good berth in rounding it; the rest of the island is steep-to.

Grosse Ile St. Martin is nearly $1\frac{3}{4}$ (2) miles long NNW. and SSE. and $1\frac{1}{2}$ ($1\frac{1}{2}$) miles broad at its widest part. Shoals extend off $\frac{1}{2}$ mile from the several points of the island. The channel between the islands is deep and safe. A course should be kept a little nearer to Ile St. Martin after passing the shoals extending from that island. This course will clear the spit extending $\frac{1}{2}$ mile off the low east point of Grosse Ile St. Martin.

The channel west of Grosse Ile St. Martin is also deep and safe in mid-channel. Shoal water extends to the eastward from Gross Point and to the westward from the NW. point of Grosse Ile St. Martin.

Coast.—Between Gross Point and Rabbits Back Peak, $3\frac{1}{2}$ (4) miles to the southward, the coast recedes forming a bay open to the eastward; south of the peak is a small bight of shoal water, open to the SE., thence the coast trends SSE. for $3\frac{1}{2}$ (4) miles to Point St. Ignace, with East Moran Bay, which is small and open to the eastward, $1\frac{1}{2}$ ($1\frac{1}{2}$) miles NW. of the point.

St. Ignace is on this bay, and projecting into the bay are several railroad docks.

Graham Shoals.—North Graham lies $\frac{3}{4}$ mile SSE. of Point St. Ignace, and has a least depth of 8-feet. South Graham lies $\frac{3}{4}$ mile SSW. of North Graham and $1\frac{1}{2}$ ($1\frac{1}{2}$) miles south of Point St. Ignace, and has a least depth of 6 feet. There is a channel between the shoals and Point St. Ignace, but it should not be attempted.

Currents.—The currents in the vicinity of Graham shoals and in the Straits of Mackinac are often strong and irregular. After fresh gales vessels anchored in the Straits often tail to windward.

Buoys.—A second-class can buoy, painted red, is moored in 15 feet of water on the south side of the center of North Graham shoal.

A first-class automatic bell buoy, painted red, is moored on the southeasterly edge of South Graham shoal in 24 feet of water. Vessels should pass south of this buoy.

Coast.—From Point St. Ignace the coast trends WSW. for $2\frac{1}{2}$ ($2\frac{1}{2}$) miles to Point la Barbe, thence it changes direction to the NW. for $2\frac{1}{2}$ (3) miles to West Moran Bay. All this coast is bordered with shoals and should not be approached within a mile.

From West Moran Bay the coast is bluff, bending to the northward as

far as Gros Cap, and is steep-to; thence it takes a northwesterly direction for $3\frac{1}{2}$ (4) miles to Point aux Chênes, becoming low and broken by inlets, with shoal water extending off some distance. From Point aux Chênes the coast trends northwesterly into Lake Michigan.

St. Helena Island lies $1\frac{1}{2}$ ($1\frac{3}{4}$) miles off the bluff, between West Moran Bay and Gros Cap. It is about a mile long NE. and SW., but shoal water extends from its SE. side for nearly $\frac{3}{4}$ mile, its outer extreme being marked by a

Buoy.—On the SE. end of a shoal extending southeastward from St. Helena lighthouse, a 25-foot spar buoy, painted black, is moored in 18 feet of water. In entering St. Helena Harbor from the westward, give this buoy a berth of 100 yards.

There is deep water between the mainland and this island.

Light.—On the SE. point of St. Helena Island is a white conical tower, 65 feet high, connected by a covered way with a red brick dwelling, having a red roof. From this tower a fixed red light is shown, visible 14 ($16\frac{1}{2}$) miles.

This light is a guide to vessels making a lee under St. Helena Island, and also a leading mark to vessels bound to the westward through the south channel of the Straits of Mackinac.

Caution.—Do not attempt to round the northwestern end of this island at night, unless its appearance under Gros Cap and the position of St. Helena shoal are well defined and understood.

St. Helena Shoal, is $1\frac{1}{2}$ ($1\frac{3}{4}$) miles west of the northwestern end of St. Helena Island, with deep water between, and with from 8 to 15 feet of water over it.

The shoal is 750 yards in extent NW. and SE., and 500 yards NE. and SW., with 8 feet on its shoalest (southeastern) edge. The soundings are irregular, bottom rocky, with from 3 to 4 fathoms close-to. On the south side of the shoal is a

Buoy.—A second-class can buoy, painted in red and black horizontal stripes, marks the southern edge of the shoal.

SOUTH SHORE.

From the NE. point of the Lower Peninsula of Michigan to Cheboygan lighthouse the coast takes a general WNW. direction for $8\frac{3}{4}$ (10) miles, and can be approached to $\frac{3}{4}$ mile. West of the lighthouse is McLeod Bay, extending to the SE., but almost filled with shoals having deep water channels amongst them.

In the western part of the bay shoal water extends a mile off shore. There is an 11-foot patch $\frac{1}{2}$ mile NW. by W. (N. $56^{\circ} 15'$ W.) from the Crib light, and a 3-foot rock one ($1\frac{1}{2}$) mile NW. by W. $\frac{3}{4}$ W. (N. $60^{\circ} 28'$ W.) from the same light.

Buoy.—At $\frac{1}{4}$ mile NNE. of Cheboygan lighthouse is Cheboygan shoal with but $14\frac{1}{2}$ feet of water over it. A second-class nun buoy, painted black, is moored in 16 feet of water on the northern side of the shoal, and should be left to the southward in passing it.

Light.—On the north point of the land to the eastward of McLeod Bay is Cheboygan light station, a square tower, 33 feet high, rising from a dwelling from which is shown a fixed white light, varied by a white flash every minute, and visible $11\frac{1}{4}$ (13) miles.

Fog Signal.—The fog signal at this station is a 10-inch steam whistle, giving a blast of 5 seconds, followed by a silent interval of 25 seconds. The fog signal building is NE. of the lighthouse.

Light.—On an isolated crib off the west side of the dredged channel into Cheboygan River is an iron octagonal tower $26\frac{3}{4}$ feet high, from which is shown a fixed red light, visible $11\frac{1}{4}$ (13) miles. Vessels bound to Cheboygan should pass the crib close-to and then take the range.

Cheboygan Range Lights are on the west side of the Cheboygan River on the prolongation of the center line of the cut and form a range for passing through the cut.

The front light is 42 feet above the lake level, shown from a square tower rising from a frame dwelling.

The rear light is 68 feet above the lake level, exhibited from an open framework-tower. The lights are fixed red, visible $7\frac{1}{2}$ ($8\frac{1}{2}$) miles, and the towers are 1,112 feet apart. The range is SSW. $\frac{1}{8}$ W. (S. $32^{\circ} 20' W.$)

Cheboygan is at the mouth of the Cheboygan River, which drains an area of 850 square miles and empties into McLeod Bay, locally known as Duncan Bay. The locality is a heavy lumber producing district, and its water traffic is important.

Improvements.—A channel 200 feet wide and 15 feet deep has been dredged from the 15-foot curve to the State Road Bridge, marking the upper limit of improvement. This channel has somewhat filled, and it is now contemplated to increase its depth to 18 feet, and extend the outer limit to the 18-foot curve. January, 1894, the available depth was about 13 feet.

A timber crib 40 feet square was built in 1881 on the north side of the entrance in 16 feet of water to mark the exact position of the cut and to serve as a guide for entering it. This crib is used as a foundation for the lighthouse previously described.

Directions.—When a mile off the crib light, make the range on a course SSW. $\frac{1}{8}$ W. (S. $32^{\circ} 20' W.$) and stand in.

Cheboygan to Lake Michigan.—Stand out with range lights or towers astern, in line, SSW. $\frac{1}{8}$ W. (S. $32^{\circ} 20' W.$) until $\frac{1}{2}$ mile outside of the crib light, when change course to NW. by W. (N. $56^{\circ} 15' W.$) and continue this course for $13\frac{1}{2}$ ($15\frac{1}{2}$) miles, when Mackinac light should be abeam, distant $\frac{6}{10}$ mile, then change course to W. $\frac{1}{8}$ N. (N. $88^{\circ} 36' W.$)

for $15\frac{1}{2}$ ($17\frac{3}{4}$) miles, which should bring a vessel abeam of Waugoshance light, distant $\frac{3}{4}$ mile; thence to port of destination.

Cheboygan to Presqu' Ile.—Stand out with range lights or towers astern, in line, SSW. $\frac{1}{8}$ W. (S. $32^{\circ} 20'$ W.) until $1\frac{1}{2}$ ($1\frac{1}{2}$) miles from the crib light, when change course to east for $6\frac{1}{2}$ ($7\frac{1}{2}$) miles, passing $\frac{1}{4}$ mile to the northward of Cheboygan Shoal buoy, thence change course to SE. by E. $\frac{3}{4}$ E. (S. $64^{\circ} 41'$ E.) for 45 ($51\frac{3}{4}$) miles, which will take a vessel off Presqu' Ile, thence to port of destination.

Cheboygan to Detour Passage.—Stand out with range lights astern, in line, SSW. $\frac{1}{8}$ W. (S. $32^{\circ} 20'$ W.) until $\frac{1}{2}$ mile from the crib light, when change course to NE. by E. $\frac{5}{8}$ E. (N. $63^{\circ} 16'$ E.) for $14\frac{1}{2}$ ($16\frac{3}{4}$) miles, passing SE. of Poe Reef lightvessel; this should bring a vessel abeam of Spectacle Reef light, thence NE. $\frac{1}{8}$ E. (N. $46^{\circ} 24'$ E.) for $14\frac{1}{2}$ ($16\frac{3}{4}$) miles, will take a vessel off the entrance to Detour Passage, with the buoy on range with Detour Point light and distant $\frac{1}{8}$ mile.

It is not advisable to pass between Poe Reef lightvessel and Bois Blanc Island, except for vessels of light draft.

Coast.—From Cheboygan the coast trends northwesterly for 13 (15) miles to Mackinac City, and it is safe to keep it at a distance of a mile. The 4-fathom curve, excepting off the mouth of the Cheboygan River, in the western part of McLeod Bay, is not more than $\frac{3}{4}$ mile off shore, but it generally follows the shore at about $\frac{1}{2}$ mile.

A little NW. of Point au Sable $4\frac{1}{4}$ ($5\frac{1}{2}$) miles NW. of Cheboygan crib light and at the village of Freedom $3\frac{1}{2}$ (4) miles further on, the edge of the curve is $\frac{3}{4}$ mile off shore.

Mackinac City, on Old Point Mackinac, is an open roadstead, and only protected from NW. winds. The best anchorage for small craft is $\frac{1}{2}$ mile off shore, SE. of the railroad pier.

Light.—On Old Point Mackinac, a light, flashing red every 10 seconds, is shown, and should be visible, in clear weather, $13\frac{1}{4}$ ($15\frac{1}{4}$) miles.

The lighthouse is a cylindrical tower, 50 feet high, and forms the NW. corner of the keeper's dwelling, both built of buff brick; roof of dwelling, red; lantern, black. Fog signal house, 80 feet east of tower, brown.

Fog Signal.—A 10-inch steam whistle gives blasts of 5 seconds duration, with alternate silent intervals of 17 and 33 seconds.

McGulpin Point is $1\frac{3}{4}$ (2) miles to the westward of Old Point Mackinac, the shore between forming a shallow bight with shoal water, open to the northward. The point is bluff, steep-to, and faces the NW. for over a mile. On the north extremity of the point is a

Light.—The light is fixed white, visible 16 ($18\frac{1}{2}$) miles.

The lighthouse, on a bluff 70 feet above the lake level, is an octagonal

tower, attached to the NW. corner of the dwelling; both of yellow brick, with red roofs.

The light is a guide through the Straits.

Coast.—From the southwestern extremity of McGulpin Point, the shore recedes to the southeastward for a mile, then trends SW. for 2 ($2\frac{1}{4}$) miles, and then NW. for a mile, forming a bay 2 ($2\frac{1}{4}$) miles wide and a mile deep, with shoal water extending out from the shore for over $\frac{1}{2}$ mile.

This bay affords protection from all winds except those from north to west. From the SW. point of this bay the coast takes a general westerly direction for 8 ($9\frac{1}{4}$) miles to Waugoshance Point, with two shallow bights open to the NW.

This part of the coast should not be approached within a mile, and as the extremity of Waugoshance Point is neared, a still wider berth should be given it.

WAUGOSHANCE POINT, ISLAND, AND SHOALS.

Waugoshance Point, a long, low, and narrow point extends out from the mainland for $1\frac{1}{4}$ (2) miles, and is further continued by several small islets. The point is the top ridge of a long shoal, which extends out from the mainland for $5\frac{1}{2}$ ($6\frac{1}{2}$) miles to Waugoshance lighthouse, the shoal having a mean breadth of $1\frac{1}{4}$ (2) miles. Waugoshance Island, $1\frac{1}{4}$ (2) miles westward of the extremity of the point, is a mile long east and west, and $\frac{1}{2}$ mile broad.

Caution.—In rounding Waugoshance shoal, do not pass between Waugoshance lighthouse and the island; keep a lookout for Vienna shoal, and give it a good berth.

Waugoshance Lighthouse, on the northwestern end of Waugoshance Shoal, is 2 miles NW. of Waugoshance Island.

The light is fixed white, varied by a flash every 45 seconds, and is visible $14\frac{1}{2}$ ($16\frac{1}{2}$) miles.

The lighthouse, 65 feet high, is an iron tower, with a dwelling and a fog-signal building, all surrounded by a square crib. The buildings are painted red and white, in alternate horizontal bands. The light marks Waugoshance shoal and the turning point into Lake Michigan.

Fog Signal.—The fog signal is a 10-inch steam whistle, giving blasts of 5 seconds duration, followed by a silent interval of 25 seconds.

Waugoshance Sixteen-Foot Shoal is $1\frac{1}{4}$ ($1\frac{1}{2}$) miles NW. of Waugoshance light, and on a line between this light and White Shoal lightvessel, and nearly on a line between St. Helena lighthouse and Grays Reef lightvessel.

These ranges will be useful in rounding this shoal at night. The shoal is marked by a

Buoy.—A second-class nun buoy, painted black, moored in 23 feet of

water; $\frac{1}{2}$ mile eastward of this buoy is an 18-foot patch. These patches are known as Rose shoal.

Vienna Shoal is $1\frac{1}{2}$ ($1\frac{1}{2}$) miles WSW. $\frac{1}{2}$ W. of Waugoshance lighthouse; it is 300 yards in length from east to west, and 175 yards from north to south, with a least depth of 13 feet. The NW. point of the shoal is marked by a

Buoy.—A second-class can buoy, painted in red and black horizontal stripes, and moored in 18 feet of water.

Grays Reef Lightvessel.—Between Vienna shoal and this lightvessel is a channel $2\frac{1}{2}$ (3) miles wide, with deep water.

The lightvessel has two masts, is schooner rigged, showing a black oval cagework daymark at the foremast head, and a red one at the main. Hull red, bulwarks white; with "Grays Reef" in large black letters on each side, and "No. 57" on the stern. The lightvessel is moored in 20 feet of water off the easterly edge of Grays reef.

A fixed white light is shown at the foremast head, and a fixed red light at the main, each at an elevation of 30 feet above the water, and visible (white) $9\frac{1}{4}$ ($11\frac{1}{4}$) and (red) $7\frac{1}{4}$ ($8\frac{1}{2}$) miles.

Fog Signal.—The fog signal is a 6-inch steam whistle, which sounds as follows: Blast, 3 seconds; silent interval, 10 seconds; blast, one second; silent interval, 10 seconds; blast, one second; silent interval, 35 seconds.

White Shoal Lightvessel, $3\frac{1}{2}$ (4) miles NE. by N. of Grays Reef lightvessel, is moored in 26 feet of water off the eastern edge of White shoal.

The lightvessel has two masts, is schooner rigged, with a black, oval cagework daymark at each masthead. The hull is white, with "White Shoal" in large black letters on each side, and "No. 56" on the stern.

A fixed white light is shown at each masthead; each being elevated 30 feet, and visible $9\frac{1}{4}$ ($11\frac{1}{4}$) miles.

Fog Signal.—The fog signal is a 6-inch steam whistle, which sounds as follows: Blast, one second; silent interval, 10 seconds; blast, one second; silent interval, 10 seconds; blast, 3 seconds; silent interval, 35 seconds.

Buoy.—A first-class, 35-foot spar buoy, painted in red and black horizontal stripes, is moored at the SW. end of White shoal in 18 feet of water.

ISLANDS AND SHOALS IN MACKINAC STRAITS.

Under this heading will be considered the islands and shoals in the Straits which lie clear of the coast line, and which can not be considered as forming bounds to bays or harbors. They will be described from the eastward.

Spectacle Reef.—This reef lies 9 ($10\frac{1}{2}$) miles east of the east point of Bois Blanc Island, and is almost in the track of ships bound from Detour

Passage to the South Channel of Mackinac Straits. The reef is $\frac{7}{8}$ mile long north and south and $\frac{1}{4}$ mile broad east and west, with a least depth of 8 feet, on its southern part. On the northwestern edge of the reef from a square crib is shown a

Light.—The light is flashing red and white, alternately, every 30 seconds, and is visible $15 (17\frac{1}{2})$ miles.

The lighthouse is a conical, gray limestone tower, 97 feet high, with a dome and railings painted black. A square wooden crib, on which are two white frame fog-signal houses, and a white frame boathouse.

This light serves as a guide to the Straits from the eastward.

Fog Signal.—The fog signal is a 10-inch steam whistle, giving blasts of 3 seconds, with alternate silent intervals of 12 and 42 seconds.

Raynolds Reef, $3\frac{1}{4} (3\frac{3}{4})$ miles to the westward of Spectacle reef, is a dangerous shoal with from 12 to 13 feet of water over it. It should not be approached nearer than $\frac{1}{4}$ mile. Its northern edge is marked by a

Buoy.—A second-class can buoy, painted in red and black horizontal stripes, is moored in 17 feet of water, and marks this shoal.

Poe Reef is $1\frac{1}{2} (1\frac{1}{2})$ miles from the SE. end of Bois Blanc Island. The reef extends easterly and westerly 2,000 yards, with a least depth of 12 feet of water over it. There is a narrow channel north of it, which should not be attempted by strangers.

On the eastern end of this reef, to mark the north side of the South Channel, in 41 feet of water, is moored a

Lightvessel.—The vessel shows simultaneously from three lens lanterns encircling the foremast head a fixed white light. The light is 40 feet above the lake level, and is visible $11\frac{3}{4} (13\frac{1}{2})$ miles. The vessel has two masts, schooner rigged, without a bowsprit. There is a circular black cagework day mark at the foremast head, with a small black smokestack, and the fog signal between the masts. The hull is red, with "Poe Reef" in large white letters on each side, and "No. 62" on each bow.

Fog Signal.—A 6-inch steam whistle sounds blasts of 5 seconds duration, separated by silent intervals of 10 seconds. If the whistle be disabled, a bell will be rung by hand.

Bois Blanc Island forms the north boundary to the South Channel, Straits of Mackinac. Its greatest length is $9\frac{1}{2} (11)$ miles WNW. and ESE. and its breadth for half this distance is $4 (4\frac{1}{2})$ miles, narrowing to a mile at its northwestern end.

About $2\frac{1}{2} (2\frac{1}{2})$ miles from its eastern end a narrow peninsula extends out from the northern shore in a northerly direction for $1\frac{1}{2} (1\frac{1}{2})$ miles, tapering at its northern edge to a breadth of but $\frac{1}{4}$ mile. On the NE. point of this peninsula is a

Light.—The light is fixed white, 53 feet above the lake level, and visible $12\frac{1}{4} (14\frac{1}{4})$ miles.

The lighthouse is a square tower, 38 feet high, on a yellow brick dwelling, and serves as a guide into the channel between Round and Mackinac islands.

Shoal.—NW. of the light, distant $\frac{1}{10}$ mile, is a shoal with 17 feet of water over it.

Life-Saving Station.—Bois Blanc Station is half way between the east and SE. points of the island.

Coast of the Island.—From the peninsula, the coast of the island trends ESE. for $2\frac{1}{2}$ ($2\frac{1}{2}$) miles and is safe to approach to $\frac{1}{2}$ mile. Shoal water extends off the east point of the island for nearly $\frac{1}{2}$ mile and follows the southeastern side at this distance until off the SE. point, when it extends off in a spit for a mile. From the southern edge shoals extend off for nearly $\frac{3}{4}$ mile, closing in to $\frac{1}{2}$ mile at the point where the southern coast changes its direction to the northwestward. The shoal water follows the trend of the coast to the NW. end of the island except at

Zela Shoal.—At half way between the NW. and SW. ends of Bois Blanc Island a narrow spit extends out northwesterly for $1\frac{1}{2}$ (2) miles from Zela point, and is marked on its extreme NW. end by a

Buoy.—A third-class can buoy, painted red. There is no channel between this buoy and the island.

The northern shore of the island for $3\frac{1}{2}$ ($3\frac{1}{2}$) miles from the north point has shoal water extending out for $\frac{3}{4}$ mile, and Bois Blanc is connected with Round Island by shoals. A rocky shoal of 3 feet lies almost on the edge of the 4-fathom curve one mile NE. of the north point with 76 feet close-to. This is a dangerous spot.

About $3\frac{1}{2}$ ($3\frac{1}{2}$) miles to the eastward from the north point, the shore becomes steep-to and continues so to the end of the peninsula. The bight formed by the peninsula gives good protection from SE. winds.

Round Island is $\frac{1}{2}$ mile from Bois Blanc Island, with which it is connected by shoals. Shoals extend eastwardly $1\frac{1}{2}$ (2) miles from the southeastern side of the island.

The NW. point of the island extends out in a long, narrow point for $\frac{1}{2}$ mile, with shoals on each side.

Shoal.—A 24-foot shoal extends almost to mid-channel between Round and Mackinac islands $1\frac{1}{2}$ (2) miles NE. from the extreme NW. point of Round Island.

Major Shoal lies $2\frac{1}{2}$ ($2\frac{1}{2}$) miles SW. by W. of the NW. point of Round Island.

The general direction of the shoal is NW. and SE., and it is 1,200 feet long. There is a least depth of 14 feet of water 400 feet SE. of the

Buoy.—A second-class can buoy, painted in red and black horizontal stripes, is moored in 19 feet of water on the middle of the shoal.

Mackinac Island, 2 ($2\frac{1}{2}$) miles eastward of Point St. Ignace, is $2\frac{1}{2}$ (3) miles long and $1\frac{1}{2}$ (2) miles broad. Its southern part, on which is the town and fort of Mackinac, forms the northern shore of the narrowest part of the Straits of Mackinac. The island is of importance as a military station.

Mackinac—The town of Mackinac, at the SE. end of the island, is directly on the north channel of the Straits of Mackinac. Many large passenger and transient steamers stop here. The town is a coaling station and is a great resort for invalids and tourists.

Harbor.—The harbor is between Biddle and Mission points. It is open to the southward and exposed to the wind from east or west, which often makes such a heavy sea that landing is impossible.

The water front of Fort Mackinac comprises nearly $\frac{1}{2}$ of the water front of the whole harbor.

Buoy.—A third-class can buoy, painted red, is moored in 16 feet of water at the end of a spit extending off from the SW. point of Mackinac Island. Vessels should pass south of it, and avoid the shoal off the NW. point of Round Island.

Directions—From the Eastward.—Steer for the middle of the passage until the docks are ranged, when haul up for them, giving the SE. point of the island a berth of $\frac{1}{4}$ mile.

From the Westward.—Should the buoy off the SW. point of the island not be seen, open up Bois Blanc light a point on the starboard bow until the red light (private light) on the south pier bears north, when haul up for the docks.

For clearing the spit off the SW. point of the island, a good range is the block house on Fort Mackinac on a line with the south pier head.

Current.—During the prevalence of strong easterly or westerly winds a strong current sets through the channel between these islands, sometimes as great as 6 or 8 knots an hour. In the harbor, inside the range of the points, the current is usually contrary to that in the passage and is caused by the eddy.

Anchorage.—Good anchorage is found in the harbor anywhere north of the range of the north pier, in from 3 to 5 fathoms of water. The docks extend out about 500 feet ESE., and have 16 feet of water at their outer ends.

There are no pilots, but tugs are available. Wharfage is charged at the rate of 5 cents per 100 pounds.

CANCELED.

CHAPTER XI.

RULES OF THE ROAD.

RULES TO BE OBSERVED BY VESSELS OF THE NAVY AND THE MERCANTILE MARINE OF THE UNITED STATES FOR PREVENTING COLLISIONS UPON THE HIGH SEAS AND IN ALL WATERS CONNECTED THEREWITH, NAVIGABLE BY SEA-GOING VESSELS.

It will be observed that the following Rules do not go into effect until March 1, 1895.

ACT OF AUGUST 19, 1890, TO ADOPT REGULATIONS FOR PREVENTING COLLISIONS AT SEA, AS AMENDED BY THE ACT OF MAY 28, 1894, AND PROCLAIMED BY THE PRESIDENT OF THE UNITED STATES TO TAKE EFFECT MARCH 1, 1895, AND ARTICLE 10 OF THE ACT OF MARCH 3, 1885.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following regulations for preventing collisions at sea shall be followed by all public and private vessels of the United States upon the high seas and in all waters connected therewith, navigable by sea-going vessels.

PRELIMINARY.

In the following rules every steam-vessel which is under sail and not under steam is to be considered a sailing-vessel, and every vessel under steam, whether under sail or not, is to be considered a steam-vessel.

The word "steam-vessel" shall include any vessel propelled by machinery.

A vessel is "under way," within the meaning of these rules, when she is not at anchor, or made fast to the shore, or aground.

RULES CONCERNING LIGHTS, AND SO FORTH.

The word "visible" in these rules, when applied to lights, shall mean visible on a dark night with a clear atmosphere.

ARTICLE 1. The rules concerning lights shall be complied with in all weathers from sunset to sunrise, and during such time no other lights which may be mistaken for the prescribed lights shall be exhibited.

ART. 2. A steam-vessel when under way shall carry—(a) On or in front of the foremast, or if a vessel without a foremast, then in the fore part of the vessel, at a height above the hull of not less than twenty feet, and if the breadth of the vessel exceeds twenty feet, then at a height above the hull not less than such breadth, so, however, that the light need not be carried at a greater height above the hull than forty feet, a bright white light, so constructed as to show an unbroken light over an arc of the horizon of twenty points of the compass, so fixed as to throw the light ten points on each side of the vessel, namely, from right ahead to two points abaft the beam on either side, and of such a character as to be visible at a distance of at least five miles.

(b). On the starboard side a green light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the starboard side, and of such a character as to be visible at a distance of at least two miles.

(c). On the port side a red light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the port side, and of such a character as to be visible at a distance of at least two miles.

(d). The said green and red side-lights shall be fitted with inboard screens projecting at least three feet forward from the light, so as to prevent these lights from being seen across the bow.

(e). A steam-vessel when under way may carry an additional white light similar in construction to the light mentioned in subdivision (a). These two lights shall be so placed in line with the keel that one shall be at least fifteen feet higher than the other, and in such a position with reference to each other that the lower light shall be forward of the upper one. The vertical distance between these lights shall be less than the horizontal distance.

ART. 3. A steam-vessel when towing another vessel shall, in addition to her side-lights, carry two bright white lights in a vertical line one over the other, not less than six feet apart, and when towing more than one vessel shall carry an additional bright white light six feet above or below such light, if the length of the tow measuring from the stern of the towing vessel to the stern of the last vessel towed exceeds six hundred feet. Each of these lights shall be of the same construction and character, and shall be carried in the same position as the white light mentioned in article two (a), excepting the additional light, which may be carried at a height of not less than fourteen feet above the hull.

Such steam-vessel may carry a small white light abaft the funnel or aftermast for the vessel towed to steer by, but such light shall not be visible forward of the beam.

ART. 4 (a). A vessel which from any accident is not under command shall carry at the same height as a white light mentioned in article two (a), where they can best be seen, and if a steam-vessel in lieu of that light, two red lights, in a vertical line one over the other, not less than six feet apart, and of such a character as to be visible all around the horizon at a distance of at least two miles; and shall by day carry in a vertical line one over the other, not less than six feet apart, where they can best be seen, two black balls or shapes, each two feet in diameter.

(b). A vessel employed in laying or in picking up a telegraph cable shall carry in the same position as the white light mentioned in article two (a), and if a steam-vessel in lieu of that light, three lights in a vertical line one over the other not less than six feet apart. The highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character as to be visible all around the horizon, at a distance of at least two miles. By day she shall carry in a vertical line, one over the other, not less than six feet apart, where they can best be seen, three shapes not less than two feet in diameter, of which the highest and lowest shall be globular in shape and red in color, and the middle one diamond in shape and white.

(c). The vessels referred to in this article, when not making way through the water, shall not carry the side-lights, but when making way shall carry them.

(d). The lights and shapes required to be shown by this article are to be taken by other vessels as signals that the vessel showing them is not under command and can not therefore get out of the way.

These signals are not signals of vessels in distress and requiring assistance. Such signals are contained in article thirty-one.

ART. 5. A sailing-vessel under way and any vessel being towed shall carry the same lights as are prescribed by article two for a steam-vessel under way, with the exception of the white lights mentioned therein, which they shall never carry.

ART. 6. Whenever, as in the case of small vessels under way during bad weather, the green and red side-lights can not be fixed, these lights shall be kept at hand, lighted and ready for use; and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side nor the red light on the starboard side, nor, if practicable, more than two points abaft the beam on their respective sides.

To make the use of these portable lights more certain and easy the lanterns containing them shall each be painted outside with the color of the light they respectively contain, and shall be provided with proper screens.

"ART. 7. Steam-vessels of less than forty, and vessels under oars or sails of less than twenty tons gross tonnage, respectively, and rowing boats, when under way, shall not be required to carry the lights mentioned in article two (a), (b), and (c), but if they do not carry them they shall be provided with the following lights :

"First. Steam-vessels of less than forty tons shall carry—

"(a). In the fore part of the vessel, or on or in front of the funnel, where it can best be seen, and at a height above the gunwale of not less than nine feet, a bright white light constructed and fixed as prescribed in article two (a), and of such a character as to be visible at a distance of at least two miles.

"(b). Green and red side-lights constructed and fixed as prescribed in article two (b) and (c), and of such a character as to be visible at a distance of at least one mile, or a combined lantern showing a green light and a red light from right ahead to two points abaft the beam on their respective sides. Such lanterns shall be carried not less than three feet below the white light.

"Second. Small steamboats, such as are carried by sea-going vessels, may carry the white light at a less height than nine feet above the gunwale, but it shall be carried above the combined lantern mentioned in subdivision one (b).

"Third. Vessels under oars or sails of less than twenty tons shall have ready at hand a lantern with a green glass on one side and a red glass on the other, which, on the approach of or to other vessels, shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

"Fourth. Rowing boats, whether under oars or sail, shall have ready at hand a lantern showing a white light which shall be temporarily exhibited in sufficient time to prevent collision.

"The vessels referred to in this article shall not be obliged to carry the lights prescribed by article four (a) and article eleven, last paragraph."—
[Act of May 28, 1894.]

ART. 8. Pilot-vessels when engaged on their station on pilotage duty shall not show the lights required for other vessels, but shall carry a white light at the masthead, visible all around the horizon, and shall also exhibit a flare-up light or flare-up lights at short intervals, which shall never exceed fifteen minutes.

On the near approach of or to other vessels they shall have their side-lights lighted, ready for use, and shall flash or show them at short intervals, to indicate the direction in which they are heading, but the green light shall not be shown on the port side, nor the red light on the starboard side.

A pilot-vessel of such a class as to be obliged to go alongside of a vessel to put a pilot on board may show the white light instead of carrying it at the masthead, and may, instead of the colored lights above mentioned, have at hand, ready for use, a lantern with a green glass on the one side and a red glass on the other, to be used as prescribed above.

Pilot-vessels when not engaged on their station on pilotage duty shall carry lights similar to those of other vessels of their tonnage.

ART. 9. Repealed by Act of May 28, 1894.

ART. 10, Act of March 3, 1885. "Open boats and fishing vessels of less than twenty tons net registered tonnage, when under way and when not having their nets, trawls, dredges, or lines in the water, shall not be obliged to carry the colored side-lights; but every such boat and vessel shall in lieu thereof have ready at hand a lantern with a green glass on the one side and a red glass on the other side, and on approaching to or being approached by another vessel such lantern shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

"The following portion of this article applies only to fishing-vessels and boats when in the sea off the coast of Europe lying north of Cape Finisterre:

"(a). All fishing-vessels and fishing-boats of twenty tons net registered tonnage or upward, when under way and when not having their nets, trawls, dredges, or lines in the water, shall carry and show the same lights as other vessels under way.

"(b). All vessels when engaged in fishing with drift-nets shall exhibit two white lights from any part of the vessel where they can be best seen. Such lights shall be placed so that the vertical distance between them shall be not less than six feet and not more than ten feet, and so that the horizontal distance between them, measured in a line with the keel of the vessel, shall be not less than five feet and not more than ten feet. The lower of these two lights shall be the more forward, and both of them shall be of such a character and contained in lanterns of such construction as to show all round the horizon, on a dark night, with a clear atmosphere, for a distance of not less than three miles.

"(c). All vessels when trawling, dredging, or fishing with any kind of drag-nets shall exhibit, from some part of the vessel where they can be best seen, two lights. One of these lights shall be red and the other shall be white. The red light shall be above the white light, and shall be at a vertical distance from it of not less than six feet and not more than twelve feet; and the horizontal distance between them, if any, shall not be more than ten feet. These two lights shall be of such a character and contained in lanterns of such construction as to be visible all round the horizon, on

a dark night with a clear atmosphere, the white light to a distance of not less than three miles and the red light of not less than two miles.

“(d). A vessel employed in line fishing, with her lines out, shall carry the same lights as a vessel when engaged in fishing with drift-nets.

“(e). If a vessel, when fishing with a trawl, dredge, or any kind of drag-net, becomes stationary in consequence of her gear getting fast to a rock or other obstruction, she shall show the light and make the fog-signal for a vessel at anchor.

“(f). Fishing-vessels and open boats may at any time use a flare-up in addition to the lights which they are by this article required to carry and show. All flare-up lights exhibited by a vessel when trawling, dredging, or fishing with any kind of drag-net shall be shown at the after-part of the vessel, excepting that if the vessel is hanging by the stern to her trawl, dredge, or drag-net they shall be exhibited from the bow.

“(g). Every fishing-vessel and every open boat when at anchor between sunset and sunrise shall exhibit a white light, visible all round the horizon at a distance of at least one mile.

“(h). In a fog a drift-net vessel attached to her nets, and a vessel when trawling, dredging, or fishing with any kind of a drag-net, and a vessel employed in line-fishing with her lines out, shall, at intervals of not more than two minutes, make a blast with her fog-horn and ring her bell alternately.” [“Re-enacted and continued in force” by Act of August 13, 1894, “so far as said article relates to lights for fishing vessels.”]

ART. 10. A vessel which is being overtaken by another shall show from her stern to such last-mentioned vessel a white light or a flare-up light.

The white light required to be shown by this article may be fixed and carried in a lantern, but in such case the lantern shall be so constructed, fitted, and screened that it shall throw an unbroken light over an arc of the horizon of twelve points of the compass, namely, for six points from right aft on each side of the vessel, so as to be visible at a distance of at least one mile. Such light shall be carried as nearly as practicable on the same level as the side-lights.

ART. 11. A vessel under one hundred and fifty feet in length, when at anchor, shall carry forward, where it can best be seen, but at a height not exceeding twenty feet above the hull, a white light in a lantern so constructed as to show a clear, uniform, and unbroken light visible all around the horizon at a distance of at least one mile.

A vessel of one hundred and fifty feet or upwards in length, when at anchor, shall carry in the forward part of the vessel, at a height of not less than twenty and not exceeding forty feet above the hull, one such light, and at or near the stern of the vessel, and at such a height that it shall be not less than fifteen feet lower than the forward light, another such light.

The length of a vessel shall be deemed to be the length appearing in her certificate of registry.

A vessel aground in or near a fair-way, shall carry the above light or lights and the two red lights prescribed by article four (a).

ART. 12. Every vessel may, if necessary in order to attract attention, in addition to the lights which she is by these rules required to carry, show a flare-up light or use any detonating signal that can not be mistaken for a distress signal.

ART. 13. Nothing in these rules shall interfere with the operation of any special rules made by the Government of any nation with respect to additional station and signal-lights for two or more ships of war or for vessels sailing under convoy, or with the exhibition of recognition signals adopted by ship-owners, which have been authorized by their respective Governments and duly registered and published.

ART. 14. A steam-vessel proceeding under sail only but having her funnel up, shall carry in day time, forward, where it can best be seen, one black ball or shape two feet in diameter.

SOUND SIGNALS FOR FOG, AND SO FORTH.

ART. 15. All signals prescribed by this article for vessels under way shall be given:

1. By "steam-vessels" on the whistle or siren.
2. By "sailing-vessels and vessels towed" on the fog-horn.

The words "prolonged blast" used in this article shall mean a blast of from four to six seconds' duration.

A steam-vessel shall be provided with an efficient whistle or siren, sounded by steam or some substitute for steam, so placed that the sound may not be intercepted by any obstruction, and with an efficient fog-horn, to be sounded by mechanical means, and also with an efficient bell. (In all cases where the rules require a bell to be used a drum may be substituted on board Turkish vessels, or a gong where such articles are used on board small sea-going vessels.) A sailing-vessel of twenty tons gross tonnage or upward shall be provided with a similar fog-horn and bell.

In fog, mist, falling snow, or heavy rain-storms, whether by day or night, the signals described in this article shall be used as follows, viz:

(a). A steam-vessel having way upon her shall sound, at intervals of not more than two minutes, a prolonged blast.

(b). A steam-vessel under way, but stopped, and having no way upon her, shall sound, at intervals of not more than two minutes, two prolonged blasts, with an interval of about one second between them.

(c). A sailing-vessel under way shall sound, at intervals of not more than one minute, when on the starboard tack one blast, when on the port

tack two blasts in succession, and when with the wind abaft the beam three blasts in succession.

(d). A vessel when at anchor shall, at intervals of not more than one minute, ring the bell rapidly for about five seconds.

(e). A vessel at anchor at sea, when not in ordinary anchorage ground, and when in such a position as to be an obstruction to vessels under way, shall sound, if a steam-vessel, at intervals of not more than two minutes, two prolonged blasts with her whistle or siren, followed by ringing her bell; or, if a sailing-vessel, at intervals of not more than one minute, two blasts with her fog-horn, followed by ringing her bell.

(f). A vessel when towing shall, instead of the signals prescribed in subdivisions (a) and (c) of this article at intervals of not more than two minutes, sound three blasts in succession, namely, one prolonged blast followed by two short blasts. A vessel towed may give this signal and she shall not give any other.

(g). A steam-vessel wishing to indicate to another "The way is off my vessel, you may feel your way past me," may sound three blasts in succession, namely, short, long, short, with intervals of about one second between them.

(h). A vessel employed in laying or picking up a telegraph cable shall, on hearing the fog-signal of an approaching vessel, sound in answer three prolonged blasts in succession.

(i). A vessel under way, which is unable to get out of the way of an approaching vessel through being not under command, or unable to maneuver as required by these rules, shall, on hearing the fog-signal of an approaching vessel, sound in answer four short blasts in succession.

Sailing-vessels and boats of less than twenty tons gross tonnage shall not be obliged to give the above-mentioned signals, but, if they do not, they shall make some other efficient sound-signal at intervals of not more than one minute.

SPEED OF SHIPS TO BE MODERATE IN FOG, AND SO FORTH.

ART. 16. Every vessel shall, in a fog, mist, falling snow, or heavy rain-storms, go at a moderate speed, having careful regard to the existing circumstances and conditions.

A steam-vessel hearing, apparently forward of her beam, the fog-signal of a vessel the position of which is not ascertained shall, so far as the circumstances of the case admit, stop her engines, and then navigate with caution until danger of collision is over.

STEERING AND SAILING RULES.

PRELIMINARY—RISK OF COLLISION.

Risk of collision can, when circumstances permit, be ascertained by carefully watching the compass bearing of an approaching vessel. If the bearing does not appreciably change, such risk should be deemed to exist.

ART. 17. When two sailing-vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other, as follows, namely :

(a). A vessel which is running free shall keep out of the way of a vessel which is close-hauled.

(b). A vessel which is close-hauled on the port tack shall keep out of the way of a vessel which is close-hauled on the starboard tack.

(c). When both are running free, with the wind on different sides, the vessel which has the wind on the port side shall keep out of the way of the other.

(d). When both are running free, with the wind on the same side, the vessel which is to the windward shall keep out of the way of the vessel which is to the leeward.

(e). A vessel which has the wind aft shall keep out of the way of the other vessel.

ART. 18. When two steam-vessels are meeting end on, or nearly end on, so as to involve risk of collision, each shall alter her course to starboard, so that each may pass on the port side of the other.

This article only applies to cases where vessels are meeting end on, or nearly end on, in such a manner as to involve risk of collision, and does not apply to two vessels which must, if both keep on their respective courses, pass clear of each other.

The only cases to which it does apply are when each of the two vessels is end on, or nearly end on, to the other; in other words, to cases in which, by day, each vessel sees the masts of the other in a line, or nearly in a line, with her own; and by night, to cases in which each vessel is in such a position as to see both the side-lights of the other.

It does not apply by day to cases in which a vessel sees another ahead crossing her own course; or by night, to cases where the red light of one vessel is opposed to the red light of the other, or where the green light of one vessel is opposed to the green light of the other, or where a red light without a green light, or a green light without a red light, is seen ahead, or where both green and red lights are seen anywhere but ahead.

ART. 19. When two steam-vessels are crossing, so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way of the other.

ART. 20. When a steam-vessel and a sailing-vessel are proceeding in such directions as to involve risk of collision, the steam-vessel shall keep out of the way of the sailing-vessel.

ART. 21. Where, by any of these rules, one of two vessels is to keep out of the way the other shall keep her course and speed.

"NOTE.—When in consequence of thick weather or other causes, such vessel finds herself so close that collision can not be avoided by the action of the giving-way vessel alone, she also shall take such action as will best aid to avert collision." (See articles twenty-seven and twenty-nine.) [Act of May 28, 1894.]

ART. 22. Every vessel which is directed by these rules to keep out of the way of another vessel shall, if the circumstances of the case admit, avoid crossing ahead of the other.

ART. 23. Every steam-vessel which is directed by these rules to keep out of the way of another vessel shall, on approaching her, if necessary, slacken her speed or stop or reverse.

ART. 24. Notwithstanding anything contained in these rules every vessel, overtaking any other shall keep out of the way of the overtaken vessel.

Every vessel coming up with another vessel from any direction more than two points abaft her beam, that is, in such a position, with reference to the vessel which she is overtaking that at night she would be unable to see either of that vessel's side-lights, shall be deemed to be an overtaking vessel; and no subsequent alteration of the bearing between the two vessels shall make the overtaking vessel a crossing vessel within the meaning of these rules, or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

As by day the overtaking vessel can not always know with certainty whether she is forward of or abaft this direction from the other vessel she should, if in doubt, assume that she is an overtaking vessel and keep out of the way.

ART. 25. In narrow channels, every steam-vessel shall, when it is safe and practicable, keep to that side of the fair-way or mid-channel which lies on the starboard side of such vessel.

ART. 26. Sailing-vessels under way shall keep out of the way of sailing-vessels or boats fishing with nets, or lines, or trawls. This rule shall not give to any vessel or boat engaged in fishing the right of obstructing a fair-way used by vessels other than fishing-vessels or boats.

ART. 27. In obeying and construing these rules due regard shall be had to all dangers of navigation and collision, and to any special circumstances which may render a departure from the above rules necessary in order to avoid immediate danger.

SOUND-SIGNALS FOR VESSELS IN SIGHT OF ONE ANOTHER.

ART. 28. The words "short blast" used in this article shall mean a blast of about one second's duration.

When vessels are in sight of one another, a steam-vessel under way, in taking any course authorized or required by these rules, shall indicate that course by the following signals on her whistle or siren, namely:

One short blast to mean, "I am directing my course to starboard."

Two short blasts to mean, "I am directing my course to port."

Three short blasts to mean, "My engines are going at full speed astern."

NO VESSEL, UNDER ANY CIRCUMSTANCES, TO NEGLECT PROPER PRECAUTIONS.

ART. 29. Nothing in these rules shall exonerate any vessel or the owner or master or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper lookout, or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

RESERVATION OF RULES FOR HARBORS AND INLAND NAVIGATION.

ART. 30. Nothing in these rules shall interfere with the operation of a special rule, duly made by local authority, relative to the navigation of any harbor, river, or inland waters.

DISTRESS SIGNALS.

ART. 31. When a vessel is in distress and requires assistance from other vessels or from the shore the following shall be the signals to be used or displayed by her, either together or separately, namely:

"In the daytime—

"First. A gun or other explosive signal fired at intervals of about a minute.

"Second. The international code signal of distress indicated by N. C.

"Third. The distance signal, consisting of a square flag, having either above it or below it a ball or anything resembling a ball.

"Fourth. A continuous sounding with any fog-signal apparatus.

"At night—

"First. A gun or other explosive signal fired at intervals of about a minute.

"Second. Flames on the vessel (as from a burning tar barrel, oil barrel, and so forth).

"Third. Rockets or shells throwing stars of any color or description, fired one at a time, at short intervals.

"Fourth. A continuous sounding with any fog-signal apparatus." [Act of May 28, 1894.]

SEC. 2. That all laws or parts of laws inconsistent with the foregoing regulations for preventing collisions at sea for the navigation of all public and private vessels of the United States upon the high seas, and in all waters connected therewith navigable by sea-going vessels, are hereby repealed.

SEC. 3. That this act shall take effect at a time to be fixed by the President by proclamation issued for that purpose.

Approved August 19, 1890.

(COLLISIONS AT SEA.)

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA.

A PROCLAMATION.

Whereas, an act of Congress entitled "An act to adopt regulations for preventing collisions at sea," was approved August 19, 1890, the said act being in the following words:

* * * * *

And, whereas, an act of Congress entitled "An act to amend an act approved August nineteenth, eighteen hundred and ninety, entitled 'An act to adopt regulations for preventing collisions at sea,'" was approved May 28, 1894, the said act being in the following words:

* * * * *

And, whereas, it is provided by section 3 of the act approved August 19, 1890, that it shall take effect at a time to be fixed by the President by proclamation issued for that purpose;

Now, therefore, I, Grover Cleveland, President of the United States of America, do hereby, in virtue of the authority vested in me by section 3 of the act aforesaid, proclaim the first day of March, 1895, as the day on which the said act approved August 19, 1890, as amended by the act approved May 28, 1894, shall take effect.

In testimony whereof, I have hereunto set my hand and caused the seal of the United States of America to be affixed.

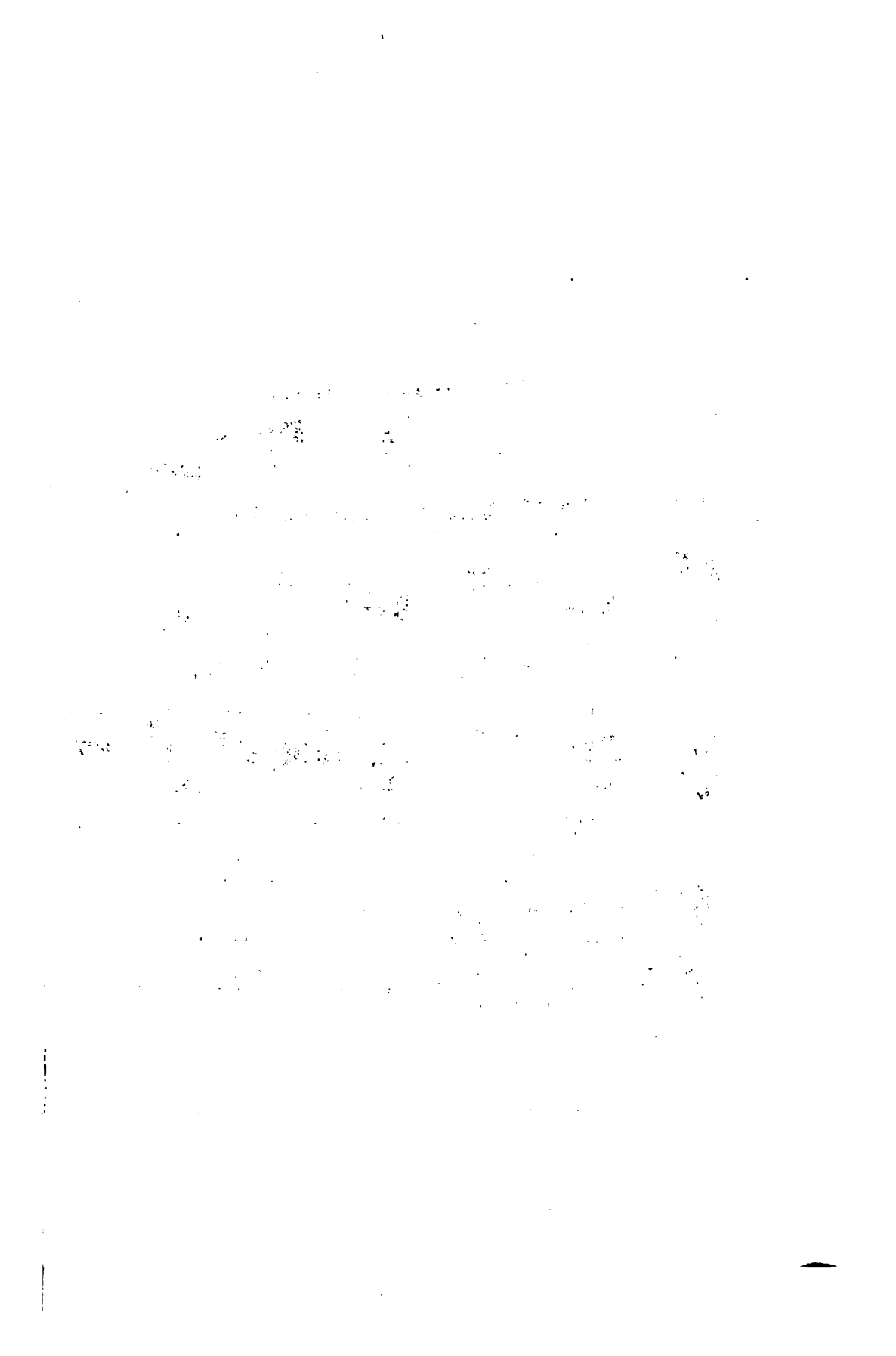
Done at the city of Washington, this thirteenth day of July, one thousand eight hundred and ninety-four and of the Independence of the United States one hundred and nineteenth.

[SEAL.]

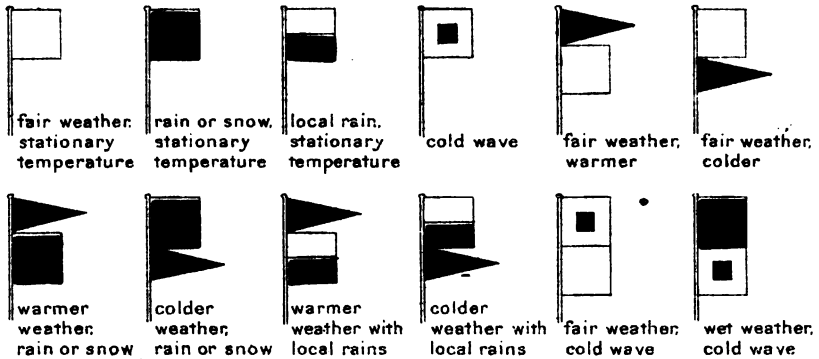
GROVER CLEVELAND.

By the President:

W. Q. GRESHAM,
Secretary of State.



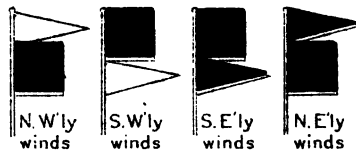
U.S. WEATHER AND TEMPERATURE SIGNALS



U.S. INFORMATION SIGNALS



U.S. STORM SIGNALS



Flags 8 feet square. Pennants 5 feet hoist and 12 feet fly.
White centers 4 feet square, black centers 3 feet square.

The Hurricane Signal indicates the expected approach of a tropical hurricane or of one of the dangerous storms which occasionally move across the lakes.

The Storm Signal indicates that the storm is expected to be of marked violence and dangerous to all classes of vessels.

The pennants when displayed alone indicate the expected direction of the wind.

NIGHT SIGNALS —By night a red light will indicate easterly winds and a white light above a red light, westerly winds.

CHAPTER XII.

SIGNALS.

UNITED STATES AND CANADA.

U. S. DEPARTMENT OF AGRICULTURE,

INSTRUCTIONS }
No. 109. }

WEATHER BUREAU,

WASHINGTON, D. C., *November 13, 1894.*

Beginning December 1, 1894, the information signals displayed at stations on the Great Lakes will indicate the expected direction of the wind, whether easterly or westerly. The red pennant will be used to indicate easterly winds, and the white pennant westerly winds. Orders to hoist these signals will specify the expected direction. Attention is called to the fact that the information signal when used at Lake stations is not a notification that a storm is expected at other Lake stations, but is a warning that winds dangerous to tows and small vessels may occur at the station displaying this signal.

U. S. DEPARTMENT OF AGRICULTURE,

INSTRUCTIONS }
No. 120. }

WEATHER BUREAU,

WASHINGTON, D. C., *December 6, 1894.*

In addition to the Information and Storm signals at present in use by this Bureau, the adoption of an additional wind signal, to be known as the "Hurricane Signal," is hereby announced, to take effect January 1, 1895.

This signal will consist of two red flags with black centers, displayed one above the other, and will be used to announce the expected approach of tropical hurricanes, and also of those extremely severe and dangerous storms which occasionally move across the Lakes and the northern Atlantic coast.

The flags will be the same as the one now used for the distinctive storm signal, the pennants being omitted. No distinctive night hurricane signal will be displayed, but when this signal is ordered during the day and is not lowered or changed before dark, the night storm signal will be displayed, the direction to be determined by the information contained in the message accompanying the order to hoist.

SIGNALS OF DISTRESS.

The Board of Trade gives notice that on and after the first of November, 1873, the following signals shall, in accordance with the 18th section of the Merchant Shipping Act, 1873, be deemed to be signals of distress:

"In the Daytime.—The following signals, numbered 1, 2, and 3, when used or displayed together or separately, shall be deemed to be signals of distress in the daytime:

"1. A gun fired at intervals of about a minute.

"2. The International Code Signal of Distress, indicated N. C.

"3. The Distant Signal, consisting of a square flag, having either above or below it a ball, or anything resembling a ball.

"At Night.—The following signals, numbered 1, 2, and 3, when used or displayed together or separately, shall be deemed to be signals of distress at night:

"1. A gun fired at intervals of about a minute.

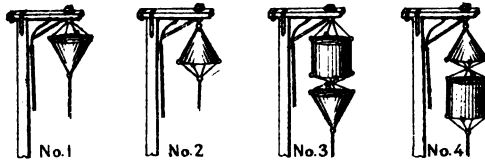
"2. Flames on the ship (as from a burning tar barrel, oil barrel, etc.).

"3. Rockets or shells of any color or description, fired one at a time, at short intervals."

And "any master of a vessel who uses or displays, or causes or permits any person under his authority to use or display any of the said signals, except in the case of a vessel being in distress, shall be liable to pay compensation for any labor undertaken, risk incurred, or loss sustained in consequence of such signal having been supposed to be a signal of distress, and such compensation may, without prejudice to any other remedy, be recovered in the same manner in which salvage is recoverable."

CANADIAN STORM SIGNALS

DAY SIGNALS



Day Signal	If displayed on Lakes Superior Erie or Ontario indicates :	If displayed on Lake Huron or in Georgian Bay indicates :
No. 1	a moderate gale is expected at first from an Easterly direction.	a moderate gale is expected at first from a Southerly direction.
No. 2	a heavy gale is expected at first from a Westerly direction.	a heavy gale is expected at first from a Northerly direction.
No. 3	a heavy gale is expected at first from an Easterly direction.	a heavy gale is expected at first from a Southerly direction.
No. 4	a heavy gale is expected at first from a Westerly direction.	a heavy gale is expected at first from a Northerly direction.

The Cone when displayed alone indicates that it is expected that the wind will attain a velocity of 25 miles an hour, but will not exceed 35 miles, and it is not intended to indicate that an ordinary, wellfound vessel should stay in port but is simply a warning that strong winds are expected from the quarter indicated.

The Drum will always be hoisted when the velocity of the wind is expected to exceed 35 miles an hour.

NIGHT SIGNALS

The Night Signal corresponding to Day Signals Nos. 1 and 3 is two lanterns hanging one above the other.

The Night Signal corresponding to Day Signals Nos. 2 and 4 is two lanterns hanging side by side.

October and November are the months in which severe storms most frequently occur on the Lakes. In these fall storms on lakes Erie and Ontario, the wind almost invariably commences at the southeast and works round through south to west and northwest, and the time of the hardest blow is usually when the barometer begins to rise as the wind gets around to the west. On Lake Huron and in Georgian Bay, the wind, though for the most part changing as on the Lower Lakes, not unfrequently changes with great suddenness, chopping after a lull from south-south-east to northwest, and blowing hardest, as a rule, from the northwest.

CHAPTER XIII.

BRIEF RULES FOR THE USE OF OIL.

BRIEF RULES FOR THE USE OF OIL TO PROTECT VESSELS IN STORMY WATERS.

From the prize essay submitted to the Hamburg Nautical School by Captain R. Karlowa of the Hamburg American Steamship Company.

In the illustrative figures, the flowing lines represent the spreading oil and the arrows denote the direction of the wind and sea.

Fig. 1

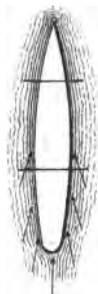


Fig. 2



Scudding before a gale, figure 1, distribute oil from the bow by means of oil-bags or through waste-pipes, it will thus spread aft and give protection both from quatering and following seas.

If only distributed astern, figure 2, there will be no protection from the quatering sea.

Fig. 3

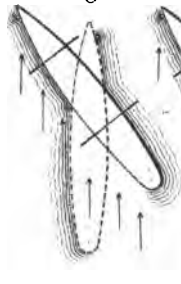


Fig. 4



Running before a gale, yawing badly and threatening to broach-to, figures 3 and 4, oil should be distributed from the bow and from both sides, abaft the beam.

In figure 3, for instance where it is only distributed at the bow, the weather quarter is left unprotected when the ship yaws.

In figure 4, however, with oil-bags abaft the beam as well as forward, the quarter is protected.

Fig. 5

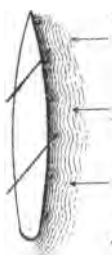
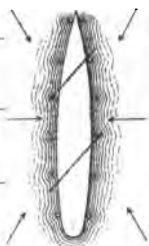


Fig. 6



Lying-to, figure 5, a vessel can be brought closer to the wind by using one or two oil-bags forward, to windward. With a high beam sea, use oil-bags along the weather side at intervals of 40 or 50 feet.

In a heavy cross-sea, figure 6, as in the center of a hurricane, or after the center has passed, oil-bags should be hung out at regular intervals along both sides.

Fig. 7

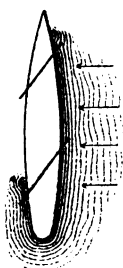
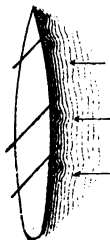


Fig. 8



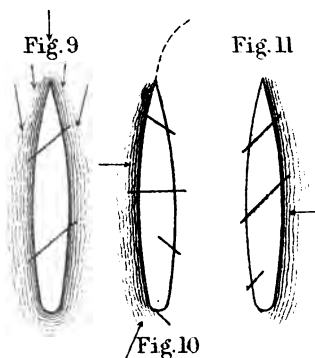
Drifting in the trough of a heavy sea, figures 7 and 8, use oil from waste-pipes forward and bags on weather side, as in figure 8.

These answer the purpose very much better than one bag at weather bow and one at lee quarter, although this has been tried with some success, see figure 7.

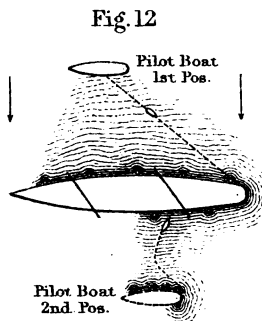
Steaming into a heavy head-sea, figure 9, use oil through forward closet-pipes. Oil-bags would be tossed back on deck.

Lying-to, to tack or wear, figure 10, use oil from weather bow.

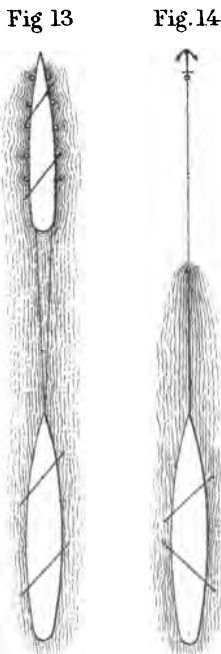
Cracking on, with high wind abeam and heavy sea, figure 11, use oil from waste-pipes, weather bow.



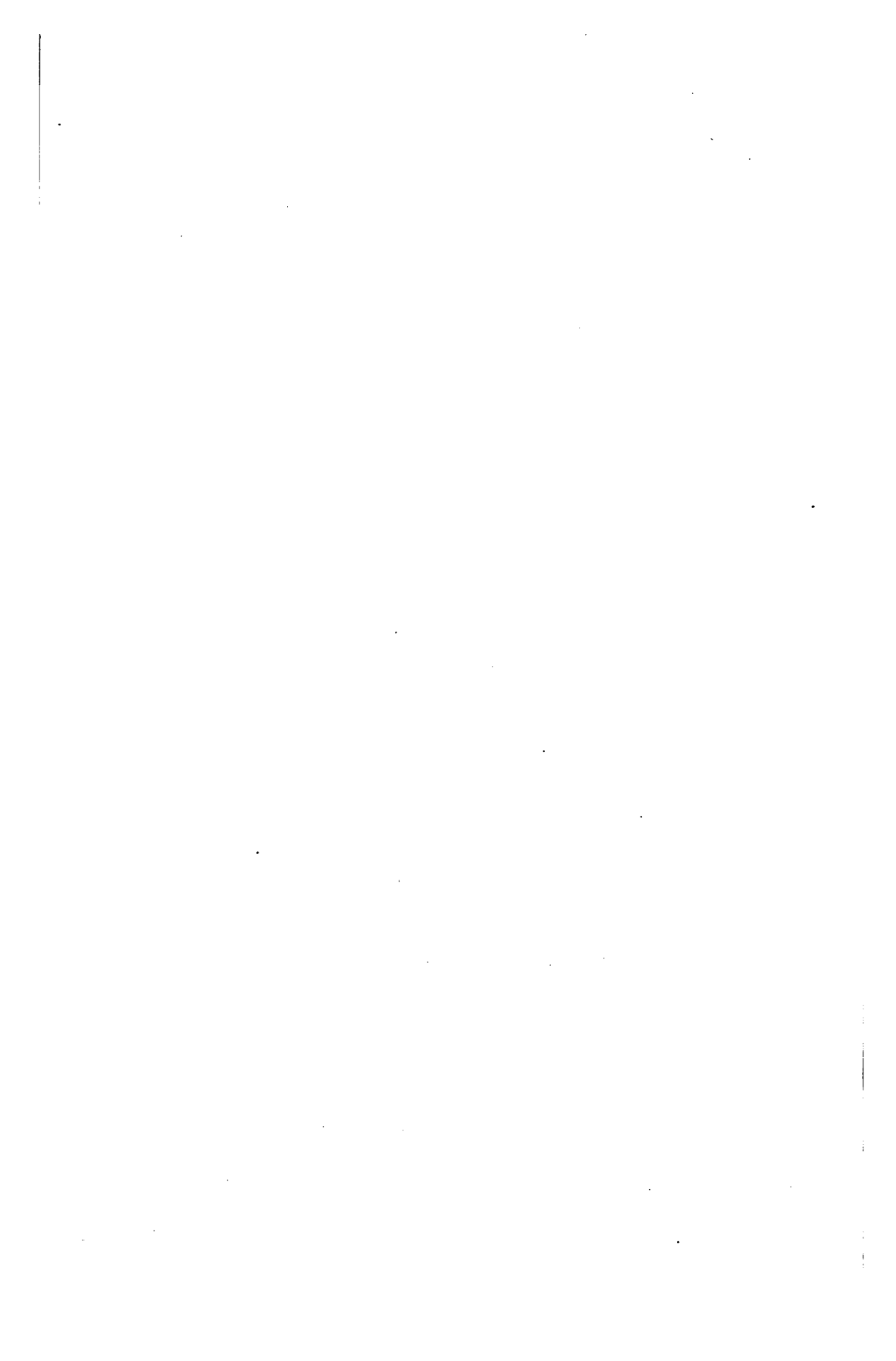
A vessel hove-to for a pilot, figure 12, should distribute oil from the weather side and lee quarter. The pilot-boat runs up to windward and lowers a boat, which pulls down to leeward and around the vessel's stern. The pilot-boat runs down to leeward, gets out oil-bags to windward and on her lee quarter, and the boat, pulls back around her stern, protected by the oil. The vessels drift to leeward and leave an oil-slick to windward, between the two.



Towing another vessel in a heavy sea, oil is of the greatest service, and may prevent the hawser from breaking. Distribute oil from the towing vessel, forward and on both sides, figure 13. If only used aft, the tow alone gets the benefit.



At anchor in an open roadstead, use oil in bags from jib-boom, or haul them out ahead of the vessel by means of an endless rope rove through a tail-block secured to the anchor-chain, figure 14.



CHAPTER XIV.

ANCHORING AND RIDING OUT GALES IN DEEP WATER.

A general rule for anchoring is to give a scope of chain three times the depth of the water, but a safer rule is to give five or even six times the depth.

In anchoring, it is desirable to lay the chain out straight, clear of the anchor. This can be accomplished by keeping headway, or by giving the vessel sternboard before letting go.

If anchoring in deep water it is best to lower the anchor into the water until its weight is taken by the chain, and then let go from the stopper inboard. In cases of anchoring in very deep water it is well to ease the anchor down to within ten or twenty fathoms of the bottom before letting go; by doing this, command can be retained over the chain, and there is less danger of losing it.

A long scope of chain acts as a buffer against the strain of sudden jerks on the anchor and chain, caused by the ship veering about, and rising or falling to the waves. The longer the scope the greater the resistance to this disturbing power.

To increase the value of the long scope a heavy kedge, or other weight, may be secured to the bight of the cable; then veer out more chain; this will bring the strain more in a horizontal direction at the anchor and prevent the latter from tripping.

North Sea fishermen, in their small vessels, use a large cask on their cables during gales of wind, secured between the vessel and the anchor, in order to reduce the direct strain on the ground tackle.

It is recommended to use an empty cask for this purpose, in case of need, and if arrangements are made for running out oil bags to the same before it is launched, the force of the sea will be much reduced, as shown in the article on the subject of oil.

This barrel buoy serves two purposes; the vessel in veering about rides more directly from the barrel buoy than from the anchor itself; hence there is less disturbing force brought upon the anchor, and less probability of fouling it.

By taking up the strain of the chain as the vessel rides up, it guards against the quick-snapping action on the chain when the vessel tautens it

out again, the buoy being dragged through the water counteracting in part this strain.

During the war of the rebellion it was a common practice for vessels on blockading duty to ride out heavy gales of wind at sea, and on a lee shore, while at anchor, with a long scope of chain, and without using oil. Admiral Porter's reports of the operations against Fort Fisher, on the coast of North Carolina, mention numerous instances of severe gales being encountered while at anchor at that point without any accident.

EXTRACTS

from the log books of several vessels during the gale of December 20 and 21, 1864, off Beaufort, North Carolina.

U. S. S. *Brooklyn*: On December 15, anchored with starboard anchor in 15 fathoms of water, veered to 45 fathoms of chain. On December 20 and 21 the wind freshened gradually to a fresh gale from the SW. and a heavy sea made. Early on the morning of the 21st, veered to 75 fathoms and at noon to 100 fathoms. Started engines ahead slow to ease chain. Heavy sea. Ship rolling heavily. Force of wind 7-9. On the 23d, the gale abating, hove in to 50 fathoms.

U. S. S. *Colorado*: Anchored on December 15, in 16 fathoms of water, veered to 60 fathoms of chain on starboard anchor. December 21, fresh gale, veered to 135 fathoms and started engines ahead slow. December 23, hove up starboard anchor and found the arms broken; let go port anchor.

U. S. S. *Tuscorora*: Anchored December 19, in 10 fathoms, veered to 55 fathoms on starboard chain. December 21, ship dragging, veered to 90 fathoms and steamed ahead slow. December 22, got underway, anchoring later in 11 fathoms with 90 fathoms of chain.

U. S. S. *Juniata*: Anchored in 13 fathoms of water with 45 fathoms of chain on starboard anchor, on December 19. On the 20th, a fresh gale blowing, with heavy sea running, veered to 60 fathoms. On the 21st, started to veer more chain. In veering parted stoppers, compressor bolt broke, and not being able to stop the chain, it tore the bolt out of the keelson and parted the end lashing, thereby losing 150 fathoms of chain and an anchor weighing 2,450 pounds. Got under way and stood out. Saw that nearly all the vessels in the fleet had dragged or were dragging their anchors. Twenty-second, anchored at 10 A. M. in 14 fathoms of water with 75 fathoms of chain on port anchor.

These vessels were out of sight of land and on a lee shore.

CHAPTER XV.

CURRENTS.

Extract from the "Currents of the Great Lakes, as deduced from the movements of Bottle Papers during the seasons of 1892 and 1893," by Mark W. Harrington, Chief of the Weather Bureau.

The currents in the Great Lakes are grouped under three heads:

1. The main currents:

A general set of the water toward the outlet exists in each of the Great Lakes, forming a continuous current in that direction.

The outlet of Lake Superior being on the southern side, this current hugs the southern shore. In Lake Michigan it hugs the eastern shore, the readiest access to the outlet being on that side, owing to the position of the islands at its northern end. The same rule holds good in Lake Huron as regards the western shore. In lakes Erie and Ontario this phenomenon is not so plainly marked.

2. Surface currents:

These are due to the prevailing winds which have always been recognized as influencing the motion of currents in large bodies of water.

3. Return currents:

The outlets of the lakes being small and insufficient for the escape of all the water banked up by the wind, return currents are inevitable.

The theory has often been propounded that many ocean currents arise from the above cause; the water driven before the wind making the current, and the piled-up water seeking an escape, forming the return current.

OTHER FEATURES.

Barometric changes, as well as other meteorological phenomena, may have an influence on the currents of the Great Lakes. A high pressure of the barometer lying over the southern end of Lake Michigan, for instance, will lower the water at that point, causing a difference of surface level between the two ends of the lake and a resulting flow of water to the southward. Such conditions, however, could hardly endure for any great length of time.

There also occurs occasionally on the Great Lakes a phenomenon which is called a "Seiche." It is a wave of considerable height, unaccompanied by other waves, appearing as a wall and moving rapidly.

From the above remarks it will be seen that the steadiness and persistence of the lake currents have not yet been determined accurately. Their velocities have been found to vary in speed from 4 to 12 miles a day.

The prevalence of westerly and southwesterly winds favor the strength and persistence of these currents, and it must be remembered that when the motion of the surface water has been communicated to the strata below, a brief change of wind, while affecting the surface, is not so soon communicated to the underlying water.

CURRENTS IN LAKE MICHIGAN.

A fresh wind of several days duration is well known to be of importance to the generally shallow harbors of the lake. Such a wind has a well recognized effect on the depth of water in the Chicago River.

As a result of experiments it has been found that a main current exists in Lake Michigan setting down the west coast about 10 miles off shore, sweeping around the south end, and stretching to the northward close to the east coast. Hugging the east shore, the current sweeps through the narrow passage east of the Manitou Islands, and thence by the Straits of Mackinac into Lake Huron, forming a whirl around the Beaver Island group on its way to this outlet.

This current is more clearly and strongly marked on the east shore than elsewhere, and it is to this that the freedom from extensive shoals and bars off the east coast is due, while broad shallows line the west coast.

Between the margin of the current and the west shore there are varying currents, sometimes to the northward and sometimes to the southward.

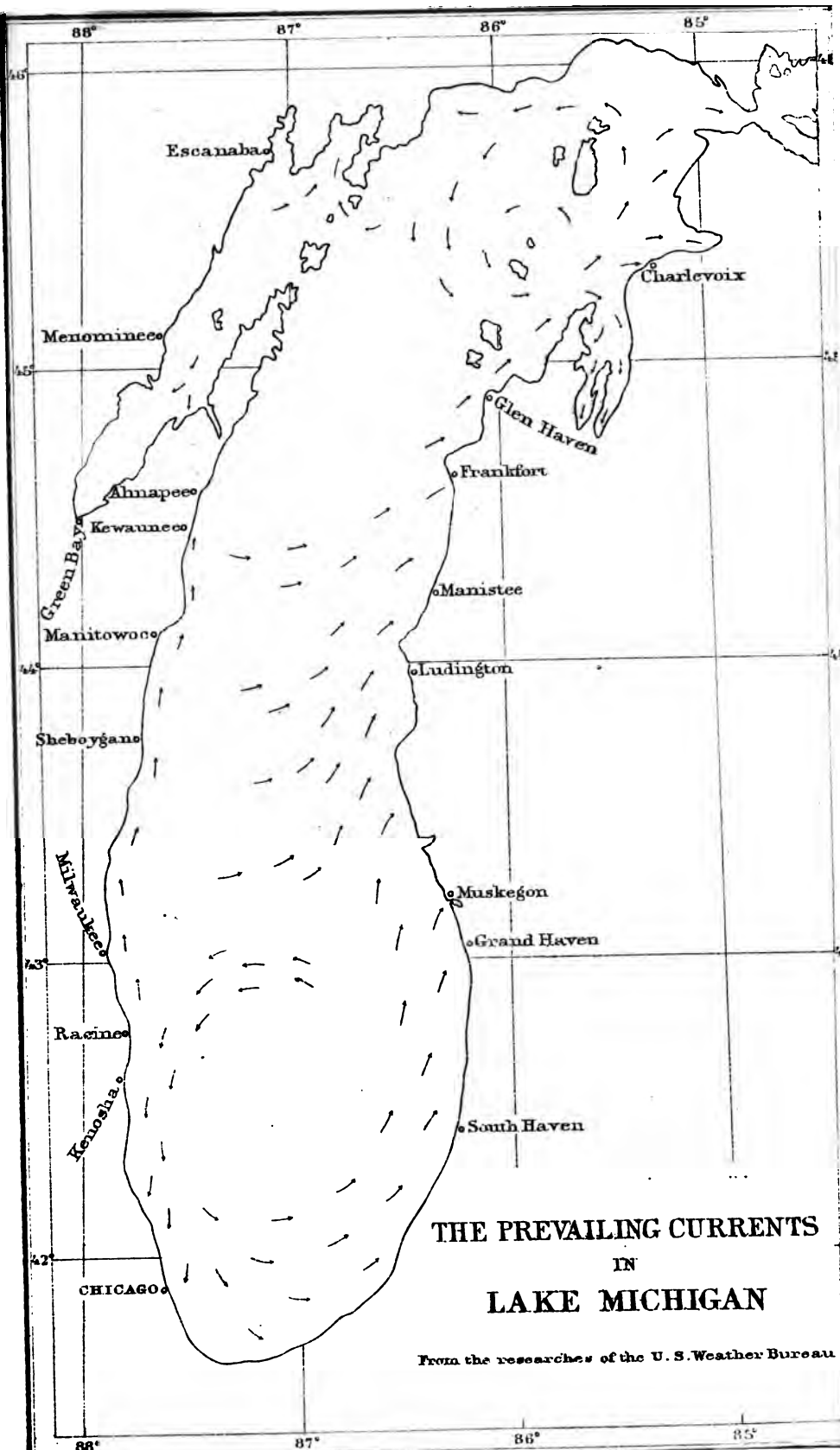
There is a whirl around Beaver Island in a direction contrary to the hands of a watch.

The average speed of the current was found to be 4 to $4\frac{1}{2}$ miles per day. Through Manitou Passage the velocity was from $6\frac{1}{2}$ to 10 miles per day.

Private observations, taken with great care, showed a current of from 36 to 96 miles per day ($1\frac{1}{2}$ to 4 miles per hour) to the northward, off Manistee, Michigan.

Some confirmation of these conclusions can be obtained from the disposition of sand spits, shoals, bars, etc., the piling up of sand against the breakwaters, and the directions of the rivers after entering the lake, the eastern ones trending to the northward, and western ones southward.

In Green and Traverse bays the currents run up the different arms, but very little is known about them.





CHAPTER XVI.

GENERAL INFORMATION.

The publications of the United States Hydrographic Office for the use of mariners, comprise charts, sailing directions, and light lists, also special books and pamphlets, issued from time to time. They are subject to frequent correction, for information relative to changes in natural and artificial features received subsequent to the date of publication.

The scheme of chart publication embraces three general classes of charts:

1. **General or Sailing Charts**, which cover a large area, and are, therefore, on a comparatively small scale. These are used for laying down routes and proceeding along them. They are for general cruising purposes.

2. **Coast Charts**, which cover less area than the general or sailing charts, and are commonly on a larger scale. They are used for coasting, and for making and leaving the land.

3. **Harbor Charts** are special charts of localities, and are intended for piloting, and for various other local purposes.

For example: A vessel at sea and out of sight of land would use a general or sailing chart. On sighting land, the coast chart would be resorted to, and for entering harbor, the harbor chart would be used.

Sailing directions give additional information, to supplement that contained on the charts, and in greater detail. Light lists also supplement the charts by giving fuller information relative to lights and fog signals. There are also buoy lists published, which give, according to the latest information, the position and character of buoys, beacons, and daymarks. These lists serve as checks upon the correctness of the charts.

The effort of the Hydrographic Office is to issue charts which shall be correct up to the date of issue, so far as information at hand permits. In the use of all Hydrographic Office publications, the date of issue should be considered.

Light Lists, published by the Hydrographic Office, which have been corrected for the latest information, are also issued. In cases where light lists published by other departments or nations are issued, the Hydrographic Office is not responsible for their correctness.

Sailing Directions can not, from their nature, be kept fully corrected by the Hydrographic Office by the insertion of slips, etc. Their date of

issue should always be carefully considered, and where they differ from charts of later issue, the chart should be taken as the guide.

Notice to Mariners.—In order that charts, sailing directions, etc., may be corrected for information received at the Hydrographic Office subsequent to the date of issue, weekly publications, styled "Notices to Mariners," are issued by the Hydrographic Office to the public free of charge. The Notices to Mariners contain brief itemized statements of special information received. The items are in such shape that they may be cut from the Notices to Mariners and pasted in books, on charts, and in the Light Lists. The Notices to Mariners also mention the publications that are affected by the several items of information. A list of charts issued and cancelled by the Hydrographic Office, and of the books published, is given in the first notice of each month.

It is seen that this scheme of supply and information assumes that navigators will keep themselves supplied with Notices to Mariners, Supplements, Light Lists, etc., in order that they may keep publications already in their possession corrected for the latest information. Notices to Mariners are supplied from the main Hydrographic Office, in the Navy Department, at Washington, D. C., or from any of the Branch Hydrographic Offices, of which there are twelve. The Branch Hydrographic Offices upon the Great Lakes are in the Masonic Temple at Chicago, and in the Arcade Building at Cleveland.

For the correction of Sailing Directions, supplements to the several volumes are published from time to time.

THE USE OF CHARTS.

It is obvious that the value of a chart can never be greater than the value of the survey from which it is made. A correct chart can not be made from an incorrect survey. Given an accurate survey, the appearance or character of a chart may be varied to suit the taste or need of those interested in its use. For mariners, all needless detail is commonly discarded in order that the information contained upon the chart may be impressed quickly upon the mind. Although the charts of the Great Lakes, as a rule, proceed from painstaking surveys, this is not true of all charts, especially certain charts of foreign coasts. To the experienced eye, the appearance of a chart affords a good basis of judgment as to its trustworthiness. In scanning a chart to judge of its value, certain points should be noticed, viz: the date of the survey and by whom the survey was made; the date of issue of the chart; the date at which it has received general correction, and the date at which it has received special corrections. As a rule it may be said that recent surveys are more accurate than those made many years ago. In many places the character of the bottom undergoes change, making resurveys necessary. For such places an old chart

should be accepted with caution. Where charted soundings are distributed evenly over a certain area, but are well opened out one from another, it does not mean necessarily that the soundings shown are all that were taken during the survey. The Hydrographic Office engraves upon its charts only characteristic soundings, and discards for the purpose of chart making soundings which are superfluous. If, on a chart intended to show details, there are no soundings placed over certain areas where they would ordinarily be expected to appear, it may mean that no survey has been made of the vacant areas. It is often the case, however, that soundings are not shown beyond a certain depth of water.

Even in the best surveys a detached pinnacle of rock or other submerged danger may not be discovered. This applies especially to rocky coasts and to the vicinity of outlying rocks. As a rule, therefore, rocky shores and patches should be given a reasonable berth. In using a chart, the notes printed upon it should be carefully read. It may be that charts published by different offices are based upon different plans. For example, one may refer to magnetic courses, and the other to true courses; one may give the bearings of an object on shore as taken from the vessel, and the other the bearing of the vessel from the object on shore. In respect to seaboard charts, one may give depths for mean low water, while the soundings on the other may refer to low water of spring tides, etc. It should also be noted whether the soundings indicate fathoms or feet. In some cases fathoms only are used; in others, only feet; while in other cases feet are designated to depths of three (3) fathoms, beyond which fathoms are shown. In the last case the water areas in depths less than three (3) fathoms or eighteen (18) feet, are dotted or "sanded."

DISTORTION OF CHARTS.

Charts printed from copperplates are subject to distortion. They are printed necessarily on dampened paper. By reason of the dampness the paper has expanded, especially in one direction; that is to say, in the direction in which the fiber of the paper runs. The dimensions of the printed chart coincide with those of the plate immediately after leaving the press, but, in drying, the paper contracts to its original dimensions, thus distorting the printed matter. Different degrees of dampness produce different degrees of distortion. It may be, therefore, that charts printed from the same chart plate at different times and under different conditions of dampness, will not coincide in all their parts if one is superimposed on the other. When this distortion takes place the compass and graduated scales on the chart are distorted in the same ratio as other matter, hence, for the purposes of navigation, no harm is likely to result from the use of plate-printed charts.

As a rule, a chart of the largest scale available should be used for coasting and piloting. For pursuing an extended route with plenty of sea room, there is an advantage in using a chart covering greater area on which both the port of destination and of departure are shown. It should be remembered, however, that in laying down a position from compass bearings, a small error of observation, when plotted, is likely to result in less displacement of position on a chart of a large scale than on one of a small scale. In one case it may reach only yards, and in the other a considerable fraction of a mile. In laying off compass bearings on the chart for fixing a position, bearings on near objects should be used in preference to those on remote objects, because an error in observing the bearing of an object by compass, would have greater effect if continued on the chart through a long distance than through a short distance. Light Lists should always be referred to, as well as the chart, in order to obtain full details of lights. Buoy Lists of the latest issue should also be used to note, when visiting a strange port, if the buoys have been plotted upon the chart according to the latest position assigned to them. In using a Light List it should be remembered, in respect to the range of visibility of a light, as given therein, that it is true only for a certain height of the eye above the water. This is commonly about fifteen (15) feet. If the eye is higher, the light should be seen farther in clear weather, and if the eye is lower, the reverse should be the case. Commonly, the meaning is, that with the eye fifteen (15) feet above water, the light will dip below the horizon when the observer is a greater distance from the light than that of the tabulated range of visibility. Sometimes, however, a light may be so high above the water that the rule as to the range of visibility would give a range beyond the carrying power of the light itself. In such cases the range of visibility is oftentimes assigned on the basis of the power of the light. A good idea of the power of the light may be formed from noting its *order* as given in the Light List.

FOG SIGNALS.

In respect to fog signals, it is almost impossible to lay down any rule as to the range of audibility. The intensity of the sound and its apparent direction are very much influenced by the wind, and to such an extent that the signal may be heard from a remote distance and yet be inaudible or very faint when nearer. Mariners should beware of placing implicit confidence in fog signals.

VESSEL'S POSITION.

Good nautical practice requires that the master of a vessel shall know continuously the position of his vessel. In well-known channels or lanes of travel, simple visual observation may give him this information close enough for practical purposes; otherwise, he must resort to the use of his nautical charts and instruments. It is especially important that a

vessel's position should be accurately plotted upon a chart when thick weather shuts out the landmarks. On extended cruises at sea astronomical observations are the main resort of navigators for finding position, but when land is in sight closer results are obtained from compass bearings of landmarks or angular intervals between them, as ascertained by observations on board the vessel. This latter practice embraces two distinct operations. First, taking the observation with the proper instruments of navigation. Second, plotting the results of the observation upon the chart to ascertain the position. The Hydrographic Office charts are plentifully supplied with compass "roses," which give both true and magnetic bearings, marked both for degrees and for compass points.

In using a chart, the theory is that the chart represents with sufficient accuracy a certain area of the surface of the globe over which the vessel is to pursue her way, and that by geometrical processes, very simple in principle, the mariner reproduces upon the chart the actual progress of his vessel along the surface of the globe. Upon the chart various landmarks are printed, all being correctly placed in their mutual relation. If at any time the master of a vessel takes a compass bearing of each of two charted landmarks, and then by means of the compass rose, plots or draws the bearings upon the chart, the intersection of the two plotted lines of bearing, if the objects have been suitably chosen, will intersect upon the chart in the position which corresponds to the actual position of the vessel in the water or upon the globe.

In taking compass bearings it should be borne in mind that certain disturbing influences enter: First, bearings taken with any compass whatever, give only what is called the magnetic bearing of the object, and not the true bearing. This disturbance is caused by the magnetism of the earth, which varies with the locality. To correct any bad results that might proceed from this cause, some charts are provided with lines or figures showing the amount of the magnetic variation in certain localities, and also with compass roses, in different portions of the chart, arranged to correspond with the actual compass in each place, if the compass were not otherwise influenced than by the magnetism of the earth. When the compass is not otherwise influenced, magnetic observations taken by means of the ship's compass, may be laid off on the chart by using the *magnetic* compass roses. Second, in using compass bearings to obtain the ship's position, note must be taken of the error which arises from the effect upon her compass of the iron on board at the time of taking the bearings. This is serious because it differs for different ships, and even for the same ship with a different cargo, or a different arrangement of cargo, when iron enters into the question. It is oftentimes very great in amount, but may be corrected by mechanical means so as to be confined within reasonable limits, so long as the amount and disposition of the iron on

board remains unchanged. If the iron, however, is changed, the local deviation, that is to say, the deviation due to the iron on board the ship, may also change, and very greatly. In order to use compass bearings effectively, for ascertaining the position of a ship, her local deviation on each course, or on each heading of the ship, should be known and applied, since it varies with the course of the ship.

Several methods of obtaining position by means of compass bearings will be given, also, the method by means of "horizontal angles." The latter, although not widely practiced by mariners, is incomparably the safer method, especially in order to get a very accurate position of the vessel when the probability of thick weather warns the navigator that he may be obliged to continue his way upon the chart without landmarks in sight, and that he should have a well defined position from which to take a departure. This method eliminates the question of compass error.

Frequently landmarks which are in range, if accurately charted, afford a certain and handy means for obtaining a position. For example, a ship may proceed upon one range which leads over a route or through a channel until she arrives upon another range, when she may perhaps change her course. A chart upon which these ranges are laid down gives at a glance the intersection of the ranges, and therefore, the position of the vessel at the time when both ranges were on.

When the chart is accurate, one compass bearing, or a range, taken in connection with a sounding, may at times give a very trustworthy position, the place of the vessel being pricked off upon the chart where the lines of bearing, or the range line, cuts the depth of water found by getting casts of the lead aboard the vessel.

Another method is by noting when two objects are in range, and then taking with a sextant or alidade, marked to degrees, at least, the horizontal angle at the vessel between the objects in range and a third object conveniently situated. The range is then penciled upon the chart and the angle laid off by means of a metal protractor, or a protractor printed upon tracing paper.

Cross-compass bearings on two landmarks have already been mentioned. When the local deviation of the compass is known, this method, it must be admitted, is more frequently used than any other; but when the vessel has much rolling or pitching motion, compass bearings are difficult to take, entirely aside from the question of local deviation. In plotting lines of bearings, the mutual relations of the lines representing angles or intersections must be considered. If the lines converge sharply upon the chart, that is to say, if the angle between the lines is small, the lines will run along each other so as to make the actual point of intersection difficult to ascertain. It is necessary, therefore, to choose such objects on shore as will give a good intersection of lines upon the chart. The

perfect intersection is when the lines cross at an angle of 8 compass points or 90° . Two compass points, or $22^\circ 30'$, is considered too small, or, at least, barely acceptable.

Sometimes a compass bearing of a single object on shore may be taken and combined with the horizontal angle at the vessel between that landmark and some other landmark which is shown upon the chart.

The best method, as already stated, because it entirely avoids compass errors, is that by two horizontal angles known among mariners as the "three point problem." For the purpose of observation there is needed a sextant, which, by the way, may be used by any one reasonably expert, even when a vessel is rolling and pitching heavily, or an alidade mounted upon a compass or otherwise mounted, and graduated to degrees, at least. By means of the sextant or the alidade, the horizontal angle, at the vessel, between two objects upon the land, known to be charted, is observed, and in connection therewith there is also observed at the same time a second angle at the vessel between one of these two landmarks and a third landmark also charted. By means of a metal or horn protractor, or a protractor printed upon tracing paper, these two angles may be transferred to the chart by so placing the sides of the angles that the several sides shall fall respectively upon the proper landmarks at the same time. The common apex of the angles is then the position of the ship for the time the angles were observed. This is the common method employed in surveying to determine the positions of the soundings which are to be placed upon the charts for the use of navigators. Habitual resort to this method will very much enhance the safety of the vessel.

Certain handy problems, in which the run of the vessel enters, are also employed to obtain the position of the ship from the observation of a single landmark. These are given and illustrated as follows:

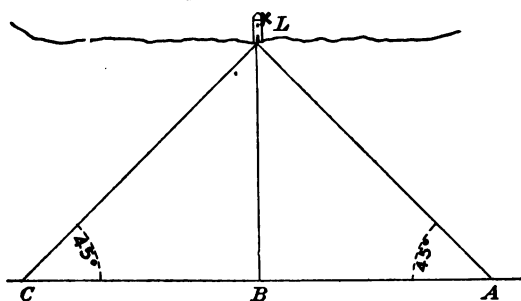


Fig. 1.

In figure 1, a vessel proceeding on her way from A to B takes a bearing of the landmark L when it bears 4 points on the bow, that is to say, 4

NOTE.—This is demonstrated as follows: The angle LBA is a right angle, and the angle BAL an angle of 45° , each having been so taken. The angle BLA is, therefore, an angle of 45° , the triangle LBA isosceles, and the side LB equal to the side BA.

points or 45° from the course on which the vessel is steering. Without changing her course, the vessel notes at B, when the landmark comes exactly abeam, the distance run by the vessel from A to B. If there has been no current to give a wrong impression of the distance run, or to deviate the ship from the course steered, the distance LB, of the ship from the landmark, when the ship is at B and the landmark bears abeam, is equal to the distance AB made by the ship between the two bearings A and B respectively.

A check on the correctness of the position at B may be had by noting the distance run from B when the landmark is 4 points or 45° on the quarter; that is to say, when the vessel is at C. In this case, again, the distance run from B to C gives the distance of the vessel from the landmark when she was at B. This is known by sailors as the "bow-and-beam-bearing" method, and is regarded as a great convenience. It is not always possible to employ this method, however.

The following more general graphical construction may be used with bearings of a single object when the lines of bearing intersect conveniently.

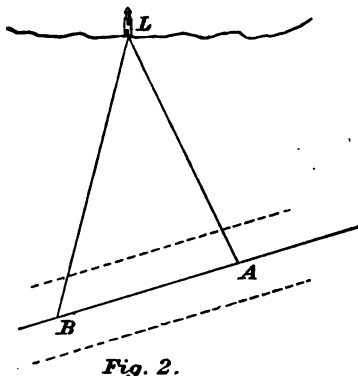


Fig. 2.

In figure 2, a vessel proceeds in the direction A to B without changing her course. At both A and B she takes a compass bearing of the landmark L, and at B notes the distance run on her course from A to B. A parallel ruler is set to the course AB by means of the compass rose on the chart, and the distance run from A to B is taken from the scale of the chart with a pair of dividers. The parallel rulers are then moved to and fro as shown by the dotted lines, and the dividers are applied to its edge until the parallel line AB is found, on which the intercepted distance AB is exactly spanned by the dividers as set by the scale. The line AB then represents upon the chart the course of the vessel, A, the point where she took her first bearing, and B the point where she took her second bearing.

THE COMPASS.

Points.	Number.	Degrees.			Number.	Points.
		°	'	"		
North	0	0	0	0	0	South.
	$\frac{1}{8}$	1	24	22	$\frac{1}{8}$	
	$\frac{1}{4}$	2	48	45	$\frac{1}{4}$	
	$\frac{3}{8}$	4	13	7	$\frac{3}{8}$	
	$\frac{1}{2}$	5	37	30	$\frac{1}{2}$	
	$\frac{5}{8}$	7	1	52	$\frac{5}{8}$	
	$\frac{3}{4}$	8	26	15	$\frac{3}{4}$	
	$\frac{7}{8}$	9	50	37	$\frac{7}{8}$	
N. by E.-----N. by W.----	1	11	15	0	1	S. by W.-----S. by E.
	$\frac{1}{8}$	12	39	22	$\frac{1}{8}$	
	$\frac{1}{4}$	14	3	45	$\frac{1}{4}$	
	$\frac{3}{8}$	15	28	7	$\frac{3}{8}$	
	$\frac{1}{2}$	16	52	30	$\frac{1}{2}$	
	$\frac{5}{8}$	18	16	52	$\frac{5}{8}$	
	$\frac{3}{4}$	19	41	15	$\frac{3}{4}$	
	$\frac{7}{8}$	21	5	37	$\frac{7}{8}$	
NNE-----NNW----	2	22	30	0	2	SSW-----SSE.
	$\frac{1}{8}$	23	54	22	$\frac{1}{8}$	
	$\frac{1}{4}$	25	18	45	$\frac{1}{4}$	
	$\frac{3}{8}$	26	43	7	$\frac{3}{8}$	
	$\frac{1}{2}$	28	7	30	$\frac{1}{2}$	
	$\frac{5}{8}$	29	31	52	$\frac{5}{8}$	
	$\frac{3}{4}$	30	56	15	$\frac{3}{4}$	
	$\frac{7}{8}$	32	20	37	$\frac{7}{8}$	
NE. by N-----NW. by N----	3	33	45	0	3	SW. by S-----SE. by S.
	$\frac{1}{8}$	35	9	22	$\frac{1}{8}$	
	$\frac{1}{4}$	36	33	45	$\frac{1}{4}$	
	$\frac{3}{8}$	37	58	7	$\frac{3}{8}$	
	$\frac{1}{2}$	39	22	30	$\frac{1}{2}$	
	$\frac{5}{8}$	40	46	52	$\frac{5}{8}$	
	$\frac{3}{4}$	42	11	15	$\frac{3}{4}$	
	$\frac{7}{8}$	43	35	37	$\frac{7}{8}$	
NE-----NW----	4	45	0	0	4	SW-----SE.
	$\frac{1}{8}$	46	24	22	$\frac{1}{8}$	
	$\frac{1}{4}$	47	48	45	$\frac{1}{4}$	
	$\frac{3}{8}$	49	13	7	$\frac{3}{8}$	
	$\frac{1}{2}$	50	37	30	$\frac{1}{2}$	
	$\frac{5}{8}$	52	1	52	$\frac{5}{8}$	
	$\frac{3}{4}$	53	26	15	$\frac{3}{4}$	
	$\frac{7}{8}$	54	50	37	$\frac{7}{8}$	

THE COMPASS — *Continued.*

Points.	Number.	Degrees.	Number.	Points.
NE. by E. NW. by W.	5	56 15 0	5	SW. by W. SE. by E.
	$\frac{1}{8}$	57 39 22	$\frac{1}{8}$	
	$\frac{1}{4}$	59 8 45	$\frac{1}{4}$	
	$\frac{3}{8}$	60 28 7	$\frac{3}{8}$	
	$\frac{1}{2}$	61 52 30	$\frac{1}{2}$	
	$\frac{5}{8}$	63 16 52	$\frac{5}{8}$	
	$\frac{3}{4}$	64 41 15	$\frac{3}{4}$	
	$\frac{7}{8}$	66 5 37	$\frac{7}{8}$	
ENE. WNW.	6	67 30 0	6	WSW. ESE.
	$\frac{1}{8}$	68 54 22	$\frac{1}{8}$	
	$\frac{1}{4}$	70 18 45	$\frac{1}{4}$	
	$\frac{3}{8}$	71 43 7	$\frac{3}{8}$	
	$\frac{1}{2}$	73 7 30	$\frac{1}{2}$	
	$\frac{5}{8}$	74 31 52	$\frac{5}{8}$	
	$\frac{3}{4}$	75 56 15	$\frac{3}{4}$	
	$\frac{7}{8}$	77 20 37	$\frac{7}{8}$	
E. by N. W. by N.	7	78 45 0	7	W. by S. E. by S.
	$\frac{1}{8}$	80 9 22	$\frac{1}{8}$	
	$\frac{1}{4}$	81 33 45	$\frac{1}{4}$	
	$\frac{3}{8}$	82 58 7	$\frac{3}{8}$	
	$\frac{1}{2}$	84 22 30	$\frac{1}{2}$	
	$\frac{5}{8}$	85 46 52	$\frac{5}{8}$	
	$\frac{3}{4}$	87 11 15	$\frac{3}{4}$	
	$\frac{7}{8}$	88 35 37	$\frac{7}{8}$	
East. West.	8	90 0 0	8	West. East.

TABLE FOR CONVERTING STATUTE MILES INTO SEA MILES.

1 statute mile = 5,280 feet.

1 sea mile or knot = 6,080 feet.

Statute miles.	Sea miles.	Statute miles.	Sea miles.	Statute miles.	Sea miles.
1.00	0.868	9.00	7.815	17.00	14.763
1.25	1.085	9.25	8.032	17.25	14.980
1.50	1.302	9.50	8.249	17.50	15.197
1.75	1.519	9.75	8.467	17.75	15.414
2.00	1.736	10.00	8.684	18.00	15.632
2.25	1.953	10.25	8.901	18.25	15.849
2.50	2.171	10.50	9.118	18.50	16.066
2.75	2.387	10.75	9.335	18.75	16.283
3.00	2.604	11.00	9.552	19.00	16.500
3.25	2.821	11.25	9.769	19.25	16.717
3.50	3.038	11.50	9.986	19.50	16.934
3.75	3.256	11.75	10.203	19.75	17.151
4.00	3.473	12.00	10.420	20.00	17.369
4.25	3.690	12.25	10.638	20.25	17.586
4.50	3.907	12.50	10.855	20.50	17.803
4.75	4.124	12.75	11.072	20.75	18.020
5.00	4.341	13.00	11.289	21.00	18.237
5.25	4.559	13.25	11.507	21.25	18.454
5.50	4.776	13.50	11.724	21.50	18.671
5.75	4.994	13.75	11.941	21.75	18.888
6.00	5.211	14.00	12.158	22.00	19.105
6.25	5.428	14.25	12.376	22.25	19.322
6.50	5.645	14.50	12.593	22.50	19.539
6.75	5.862	14.75	12.810	22.75	19.756
7.00	6.079	15.00	13.027	23.00	19.973
7.25	6.296	15.25	13.244	23.25	20.191
7.50	6.513	15.50	13.461	23.50	20.408
7.75	6.730	15.75	13.678	23.75	20.625
8.00	6.947	16.00	13.895	24.00	20.842
8.25	7.164	16.25	14.112	24.25	21.060
8.50	7.381	16.50	14.329	24.50	21.277
8.75	7.598	16.75	14.546	25.00	21.711
$\frac{1}{4}$	0.217	$\frac{1}{2}$	0.434	$\frac{3}{4}$	0.651

SEA MILES TO STATUTE MILES.

TABLE FOR CONVERTING SEA MILES INTO STATUTE MILES.

1 sea mile or knot = 6,080 feet.

1 statute mile = 5,280 feet.

Sea miles.	Statute miles.	Sea miles.	Statute miles.	Sea miles.	Statute miles.
1.00	1.151	8.75	10.075	16.50	18.999
1.25	1.439	9.00	10.363	16.75	19.287
1.50	1.729	9.25	10.651	17.00	19.575
1.75	2.015	9.50	10.939	17.25	19.863
2.00	2.303	9.75	11.227	17.50	20.151
2.25	2.590	10.00	11.515	17.75	20.439
2.50	2.878	10.25	11.803	18.00	20.727
2.75	3.166	10.50	12.090	18.25	21.015
3.00	3.454	10.75	12.378	18.50	21.303
3.25	3.742	11.00	12.666	18.75	21.590
3.50	4.030	11.25	12.954	19.00	21.878
3.75	4.318	11.50	13.242	19.25	22.166
4.00	4.606	11.75	13.530	19.50	22.454
4.25	4.893	12.00	13.818	19.75	22.742
4.50	5.181	12.25	14.106	20.00	23.030
4.75	5.469	12.50	14.393	20.25	23.318
5.00	5.757	12.75	14.681	20.50	23.606
5.25	6.045	13.00	14.969	20.75	23.893
5.50	6.333	13.25	15.257	21.00	24.181
5.75	6.621	13.50	15.545	21.25	24.468
6.00	6.909	13.75	15.833	21.50	24.757
6.25	7.196	14.00	16.121	21.75	25.045
6.50	7.484	14.25	16.409	22.00	25.333
6.75	7.772	14.50	16.696	22.25	25.621
7.00	8.060	14.75	16.984	22.50	25.909
7.25	8.348	15.00	17.272	22.75	26.196
7.50	8.636	15.25	17.560	23.00	26.484
7.75	8.924	15.50	17.848	23.50	27.000
8.00	9.212	15.75	18.136	24.00	27.636
8.25	9.500	16.00	18.424	24.50	28.212
8.50	9.787	16.25	18.712	25.00	28.787

DRAFT IN SALT AND FRESH WATER.

With regard to the amount a vessel will rise in passing from fresh to salt water, the following table shows approximately :

Moulded depth in feet.	Approximate amount of rise of a vessel passing from fresh to sea water.		
	Vessels without erections on deck.	Awning deck vessels.	Spar deck vessels.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
9 and under 11.....	2	-----	-----
11 and under 13.....	2½	-----	-----
13 and under 16.....	3	3½	4
16 and under 19.....	3½	4	4½
19 and under 22.....	4	4½	5
22 and under 25.....	4½	5	5½
25 and under 28.....	5	5½	6
28 and under 31.....	5½	6	6½
31 and under 34.....	6	6½	7

The weight of a cubic foot of salt water being taken to be 64 pounds; that of fresh water 62.5 pounds.

This table applies, as a general rule, for all except those of extremely full or extremely fine form.

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